Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA.

VOL. XLI. No. 19. NEW YORK, SATURDAY, NOVEMBER 8, 1902. ISSUED WEEKLY

ELECTRICAL REVIEW

13 to 21 Park Row NEW YORK

BY THE

ELECTRICAL REVIEW PUBLISHING COMPANY

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REGISTERED CABLE ADDRESS — "Electview," New York.

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One Year, United States and Canada $3.00
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Single Copies, each 10
Copies supplied for only one year back, each . . 25

As electrical applications are extended and processes improved, the engineer finds it necessary to call to his aid other sciences. We have seen electrical engineering and chemistry working together to develop electrometallurgical processes, and it is a noteworthy fact that they have again joined hands to improve the electric light.

Members of the American Institute of Electrical Engineers residing in the neighborhood of Pittsburg have organized a local section. It is to be hoped that their example will be followed by others and that before long there will be active organizations in every large town. The board of managers has adopted a liberal policy and, while cooperating as far as possible, will leave the details of each local organization largely to its own members.

VALUE OF ANALOGIES.

The value of analogies in assisting in the explanation of electrical phenomena has been under discussion of late. While doubtless a help when properly used, has not their value been overestimated?

The aim is to assist the imagination by substituting something that appeals to the senses. We can not see the current of electricity, though we are conscious of it through some of its effects. We therefore substitute for it a current of water.

This is easier to think about, because we are familiar with water, and have a general idea of its behavior in its passage through pipes. The benefit of this hydraulic analogy, however, is not so great as first appears. We have substituted matter for something else, but the matter can not be seen while in the pipe; and, on the other hand, this hydraulic analogy implies properties which the electric current has not, such as weight and volume.

Even the word "current," which is universally used, suggests something that flows. It embodies the idea of motion along the wire, and when an ampere is compared with the rate of flow of water, the idea of velocity is suggested.

It was with something of this feeling that Faraday wrote: "The word 'current' is so expressive in common language that when applied to the consideration of electrical phenomena we can hardly divest it sufficiently of its meaning to prevent our minds from being prejudiced by it. I shall use it in its common electrical sense, namely, to express generally a condition and relation of electrical forces supposed to be in progression, an axis of power in every part of which both electric forces are present in equal amount." Oliver Heavyside speaks of the same matter as "the essentially vicious practice of associating the current in the wire with the motion through the wire of a hypothetic quasi substance, which is a pure invention that may well be dispensed with."

The opinions of two such authorities ought to be well considered by all, but especially by those by whom the student is first introduced to the science.

THE HYDRAULIC POWER PLANT OF THE CONSOLIDATED LAKE SUPERIOR COMPANY.

The opening of the hydraulic power plant of the Consolidated Lake Superior Company, which took place October 25 with fitting ceremonies, marks another advance in the development of our water powers.

The undertaking here presented many difficult engineering problems. The fall of water available is but twenty feet, and the discharge from the lake varies from three and one-half to seven million cubic feet a minute.

Possibilities of development at the Sault have long been attractive to investors. As early as 1885 an attempt was made to exploit the falls by the St. Mary's Falls Water Power Company. Electrical developments at that time were not far enough advanced to be considered here, and to distribute the large amount of power by other means presented very great difficulties.

In 1891 local capitalists on the Canadian side started a canal, but for financial reasons were unable to complete it. In 1894 the Lake Superior Power Company undertook to develop power on both sides of the Sault, and it carried to completion a twenty-thousand-horse-power canal on the Canadian side, using the power to manufacture paper pulp. A second canal is now being constructed on the Canadian side which, when completed, will develop fifty thousand horse-power.

The present canal will develop about sixty thousand horse-power, the greater amount of which will be used in the building. We are apt to think that the progress of electrical transmission has had much to do with the development of our waterfalls. This has undoubtedly been the case in many instances, and notably so in the far West, but here only a small part of the power generated will be transmitted to any appreciable distance. This

is also true of the wonderful developments at Niagara.

When the utilization of large water powers was first considered, two methods were discussed: First, it was thought that large plants could be constructed which would sell mechanical power. This was the plan first adopted when the work at Niagara was begun. The other plan contemplated the transmission electrically to distant points of power developed at the falls. Now we see neither of these adopted. The power is developed electrically, but the plants making use of this are moved to the point of generation. The amount of energy transmitted to a distance in these cases is comparatively small.

Sault Ste. Marie is already famous as having the greatest water traffic in the world. It now promises to become one of the greatest industrial centres.

SIGNALS FOR ELECTRIC RAILWAYS.

The development of electric railways along the lines of steam railroad practice calls for the adoption of some system of block signals, and although something has been done along this line the adoption of means for preventing accidents has not been as general as could be wished.

There are a number of suitable systems for operating block signals for electric roads which are not too expensive and are simple enough to be reliable. Since electric roads have already power distributed along the line, the installation of some form of electric signaling should not be difficult.

There is one simple system for operating single-track roads which requires but a comparatively small outlay for its installation. This is known as the "staff" system, and its operation is about as follows: At each end of a section or block a box is placed for holding the staff. This latter is nothing more than a small rod of any description, suitably marked to indicate the section of road to which it belongs. No car is permitted to pass over that section of the road unless the staff is carried along. There is an exception to this rule, which will be mentioned presently. When a car reaches any section of track and finds the staff in the box, this is removed and carried with the car to the other end of that section, where it is placed in the receiving box and the staff for the next section of the road taken, when the car proceeds upon its way. When a car reaches a section and finds that the staff is not there, this indicates that a car is already traveling over that section of road and passage is prohibited until the staff has been returned by a car passing in the opposite direction.

The system, if this rule is strictly adhered to, is safe and simple, but presents one or two disadvantages. One of these arises from the fact that if one car passes over a section in one direction, the next car to pass over that section must pass in the opposite direction so that the staff may be returned to its starting point. Should a car be delayed for any reason, a rigid adherence to these rules will throw back all of the cars by the same time and the operation of the whole road will be interfered with. To overcome this difficulty, the rule is modified and several cars may pass over one section in the same direction provided that they see the staff before they enter this section. The last of these cars carries the staff as usual. This modification, of course, assists in the operation of the road, but it offers no assurance from a rear-end collision.

A somewhat similar system to this substitutes electric lamps for the staff. At each end of a block two lamps are placed in a suitable case, and a switch is provided which lights one of these and turns off the other. Each of these two lamps is connected to a similar lamp at the distant ends of the two blocks starting from this point. The system operates in this way: When the car reaches the end of a block the conductor throws a switch which, by means of the lamps, opens the section he has just left to any car passing in either direction, and at the same time closes the section into which the car is entering. There is little here to get out of order, the block system can be retained absolutely, and the delay of one car need not interfere seriously with the operation of the road.

But, as usually installed, a few minor modifications would, we think, materially increase the efficiency of the system. In many cases the conductor must leave the car and walk some little distance to manipulate the switches. This, of course, is easily rectified by placing the switch so that it can be reached from the car; but in this case the motorman can not see whether the signals are properly set, and it is, of course, desirable to hold both men responsible for the proper operation of the system. The suggestion naturally follows that the lamps might be placed at a distance from the switch, and we see no reason why this should not be done.

These two systems, which we have merely outlined, show that the problem is not a difficult one, although troubles of a more or less serious character may be met with in practice. A number of systems similar to these could be developed without much expense, and would most assuredly assist in preventing accidents. It therefore seems strange that electric roads have not adopted more generally some such plan. One can not expect a perfect system to be offered at once, but perfection can only be attained through use and improvement.

Car equipments are increasing in weight and speeds are growing greater, so that conditions in the near future will necessitate the adoption of a satisfactory block system, and we think the roads should cooperate more freely with and bring more practical assistance to the aid of those who are engaged in developing the systems.

HIGH-SPEED ELECTRIC TRACTION TESTS IN GERMANY.

On another page of this issue will be found a description of the high-speed experiments recently carried out in Germany. These tests were made with a locomotive, as distinguished from the previous tests made with a motor-equipped passenger car, the idea here being to save expense, as well as to gain an insight into the relative advantages of motor cars and locomotives for work of this character.

The principal interest in this equipment centres in the use of high-voltage induction motors. The line pressure of

ten thousand volts, three-phase, is collected by the usual bow-shaped trolleys, and is applied, without the interposition of transformers, to the motors. This plan made necessary the use of a revolving secondary, and called for the most careful construction, insulation and winding of the primary of the motors.

To develop ten thousand volts directly from an alternator is no mean feat for the designer, but to use this pressure on a railway motor directly seems almost to be courting trouble.

The object of this construction was to save the expense of transformers. Transformers, however, are not expensive, compared with other electrical machinery, and this saving will be partially balanced by the increased cost of the motors. Moreover, since these tests were carried out with a locomotive, the additional weight of transformers would not seem to be objectionable, while it is doubtful if it will be thought desirable to introduce such high voltages into passenger cars. The behavior of this equipment was most satisfactory, and speeds as high as ninety-four miles per hour were reached, but it is yet to be shown whether these motors will be reliable under the severe conditions of actual service. The same difficulties as were encountered in the tests with the motor cars last fall were met with, the track construction being entirely inadequate for the severe strains thrown upon it. The motors are controlled by introducing resistance into the secondary circuit. This, of course, is not economical, but gives a very simple and reliable method of starting and varying the speed.

The performance of this locomotive was found to be somewhat better than had been attained by steam, the weight of train per passenger being about thirty per cent less. This shows that the power required to operate electric trains may be considerably less than that called for by steam locomotives and moreover indicates that the cost for track maintenance will be appreciably less. These two points are of prime importance in considering the conversion of steam roads into electric.

It is the intention to carry on these tests at a still higher speed, as soon as the road-bed can be made sufficiently durable. Work on this is now going on, and further data will undoubtedly soon be available.

TROLLEY WIRE SPECIFICATIONS.

A peculiar condition in electric railway engineering was revealed to us recently. Having occasion to make some enquiries regarding specifications for trolley wire, we found a wide variation in practice. Some engineers call for one quality of wire—others for another; some specify certain conductivities—others make no requirements in this regard. Sometimes certain possible impurities are mentioned, and their elimination demanded. In some cases the engineer deems it sufficient to specify simply the size of the wire.

Trolley wires, as well as other wires, are now standard articles of commerce. The properties of the wire, both physical and electrical, are well known and are given in all hand-books. Having this fact in mind, we expected to find practice pretty well defined and specifications calling for similar properties; but, as already stated, this condition seemed not to exist.

The supply houses, indeed, state that when specifications come in for trolley wire, if these do not conform to their standard article, either no attention is paid to them, or a request is sent to the engineer asking that an inspector be sent to the wire factory to pass upon the wire there. It seems that it is not customary for the purchaser to test the wire after it has been received, so that the requirements made in the specifications amount to nothing. Indeed, it was stated that frequently these requirements could not be met because of the impossibility of furnishing a wire of the specified conductivity having, at the same time, the required mechanical properties.

Recently, attention was called to the desirability of standardizing the electrical engineering practice, and this case which has come under our observation shows how greatly this is needed. Trolley wire is a simple article. Its electrical and mechanical properties are easily tested, and every factory knows very accurately just what quality of wire it is turning out. It therefore seems somewhat absurd for the electrical engineer to call for a quality of wire if he is not going to see to it that he secures this. It is even more absurd to call for a wire which can not be furnished by the maker. On the other hand, to merely state the size of the wire desired does not seem to sufficiently safeguard the company by whom the engineer is employed.

It would not be a difficult matter for the wire makers and the engineers to get together and decide upon standards for trolley and other wires; and we suggest that this offers an opportunity to begin the standardization of electrical engineering practice, the need for which Mr. C. F. Scott recently emphasized.

JOHN FRITZ.

Mr. John Fritz is the son of a small farmer in Chester County, Pa. At the age of sixteen, having had but little training at school, he left farming and found work in a machine shop in Parkersburg. From here, after a few years, he went to Safe Harbor, Pa., to direct the installing of machinery for a rolling mill. He then became manager of an anthracite blast furnace at Norristown, and in 1854 took charge of the remodeling and rebuilding of the plant of what is now the Cambria Steel Company. He returned in 1860 to the Lehigh Valley, and founded the company which later became the Bethlehem Steel Company, and it was under his hand that it attained its present importance.

Mr. Fritz is the inventor of many important machines for working iron, not the least among which is the three high roller, which was first installed in the Johnstown works. The value of this invention, which made the process of rolling iron practically continuous, can hardly be overestimated.

He was selected by the government to decide upon the advisability of erecting an armor-making plant, and his opinion is well known. He has received the Bessemer medal, awarded by the British Iron and Steel Institute, and has just been awarded the John Fritz medal, probably the highest honor ever conferred upon a man by his brother engineers.

Mr. Fritz has been called the "Father of mechanical engineering." He is past-president of the American Society of Mechanical Engineers and of the American Institute of Mining Engineers. He is now eighty years old, and this event was recently celebrated by a notable gathering of men eminent in all lines of work.

Mr. Fritz is vigorous in mind and body, and is still active in public and private works. Personally he is a man of the highest and most amiable character, and is everywhere honored and beloved.

LOADS ON ELECTRIC STATIONS.

BY ALTON D. ADAMS.

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Maximum loads on electrical supply stations vary with the seasons. The ratio of average to maximum loads also changes from month to month. To illustrate these variations, the maximum load, average load and ratio of the average to the maximum load of a large system of electrical supply are here given for a typical week-day in each month during a recent year. On a January day of this year the maximum load on the system was 2,720 kilowatts, for the July day the figures were down to 1,390 kilowatts, and in December the maximum load was 2,840 kilowatts or a little greater than that in January. From this it appears that only one-half of the generator capacity necessary in January and December can be employed in July. The maximum load shows a large decline between February and March, a large rise from September to October, and only moderate variations from March to September, inclusive. If the maximum load of the January day is taken as 100 per cent, the like loads in February, October, November and December are each more than 89 per cent, but none of the loads in the remaining seven months was more than 65 per cent of the January figures. More than one-third of the generating equipment at this station was thus necessarily idle at all times during seven months of the year. Storage batteries are included under the head of generating equipment, and a part of the capacity otherwise necessary in dynamos may, of course, be provided for by batteries.

Average daily loads vary much less than do maximum loads, and consequently the percentage of the former to the latter is far from uniform. These average daily loads are obtained, in each case, by a division of the total kilowatt-hours of output for the day by 24, this giving the average load in kilowatts for each hour of the day. The smallest ratio of average to maximum load was in February, when the former was 43 per cent of the latter, and the largest percentage was in July, when it stood at 75. In each of five months of the year the average was not more than 55 per cent of the maximum load, and during the seven remaining months the percentage for the average load was from 59 to 75. These figures have an important bearing on the application of storage batteries in systems of electrical supply. With all the battery capacity that could be made use of, and dynamos operating at full load during the twenty-four hours of each week-day, the dynamo capacity required in December corresponding to average load was 46 per cent greater than that necessary in July, while the maximum load was twice as great. Neglecting losses in the batteries, if all the dynamos were operated continuously during each week-day, then 57 per cent of the maximum load might be carried by batteries in February, but only 25 per cent in July. As it is not generally practicable to operate dynamos twenty-four hours daily, it is necessary that dynamo capacity exceed the average load so that the running time of dynamos shall not be greater than, say, twenty hours daily, and to cover battery losses.

It follows, if all dynamos are operated at full capacity during maximum loads, that the percentages of these loads that may be carried by batteries are smaller than the corresponding percentages of average to maximum loads.

WEEK-DAY LOADS.

	Maximum Kilowatt.	Average Kilowatt.	Per Cent Average to Maximum.
January.....	2,720	1,260	46
February....	2,470	1,076	43
March.....	1,690	1,045	61
April.....	1,760	1,103	62
May.	1,720	1,032	60
June	1,420	921	64
July	1,390	1,046	75
August.....	1,620	997	61
September...	1,760	1,044	59
October.... .	2,460	1,154	47
November...	2,430	1,349	55
December....	2,840	1,342	47

The sum of average loads for the twelve months divided by twelve gives the average load for the year. This average yearly load is 1,114 kilowatts, or 40.9 per cent of the maximum load in December. In other words, the output of energy for the year was 40.9 per cent of what it would have been if the station had operated continuously during twenty-four hours per day at the maximum December load. In December, January and February the maximum loads came on between 4 and 5 P. M. Maximum load in March occurred between 6 and 7 P. M.; in April, October and November between 5 and 6 P. M.; in August from 7 to 8 P. M., and in September from 8 to 9 P. M. For June and July the maximum load, largely of motors, was carried between 10 and 11 A. M.

Energy outputs of an electric station show smaller variations from month to month than its maximum loads, but are far from constant. On the other hand, different stations are apt to vary more as to the amounts of their delivered energy than as to figures for their maximum loads. This latter is due largely to the fact that the proportions of street lamps, commercial lamps and motors in the capacities of connected loads in various systems are widely different. To illustrate the changes of energy outputs from month to month, and also the effect on these changes of street and commercial lamps, and of motor loads, data are here presented of four electrical supply systems. These systems had December outputs that were between 40,000 and 50,000 kilowatt-hours for the smallest, and between 800,000 and 900,000 kilowatt-hours for the largest. For each system the percentage of the kilowatt-hours delivered during each of the eleven months following July to the kilowatt-hours delivered during July is given. These percentages are illustrated, in each case, by a curve. All four curves show a gradual increase of monthly output between July and December, and in three cases there is a general decline from December to June. For three systems the energy output was lowest during July and highest during December. In the smallest system, January shows the largest delivery of energy, and this delivery was smaller in March, April and May, respectively, than in the previous July. The kilowatt-hours delivered during December were 62 per cent greater than the output for July in one system, 56 per cent greater in each of two others, and in the smallest plant the output of January was 33 per cent greater than that of the previous July. Data given in three cases relate to the twelve months ending June 30, 1901, and data in the other case relate to the twelve months ending June 30, 1900.

Curve 1 represents the ratio of the energy delivered in each month to that delivered during July, for a system which supplied more energy for stationary motors than for lighting. On this system the total connected load of lamps and motors had a capacity of 755 kilowatts, which was made up of 44 per cent in commercial lamps, 10.5 per cent in street lamps and 45 per cent in stationary motors. So the large percentage of the motors to the total load and to the fact that fifteen of these motors had an average capacity of 24 horse-power each, the unusual percentages of outputs in the other months to that of July. The greatest monthly output of the system represented by curve 1 was only one-third greater than that of July. The low percentages of March, April and May were

due to the fact that some of the large motors were not then in use.

Curve 2 represents a system on which the connected capacity of lamps and motors was 2,567 kilowatts. Of this capacity 10 per cent was made up of motors, 14 per cent street lamps and 76 per cent of commercial lamps.

During December the output of this system was 62 per cent greater than that in July. The fact that the February output was only 28 per cent greater than that of July was no doubt due in part to the shortness of the former month, but this cause seems too small to account for the difference between February and March.

PERCENTAGES OF MONTHLY OUTPUTS OF ENERGY TO THOSE OF JULY.

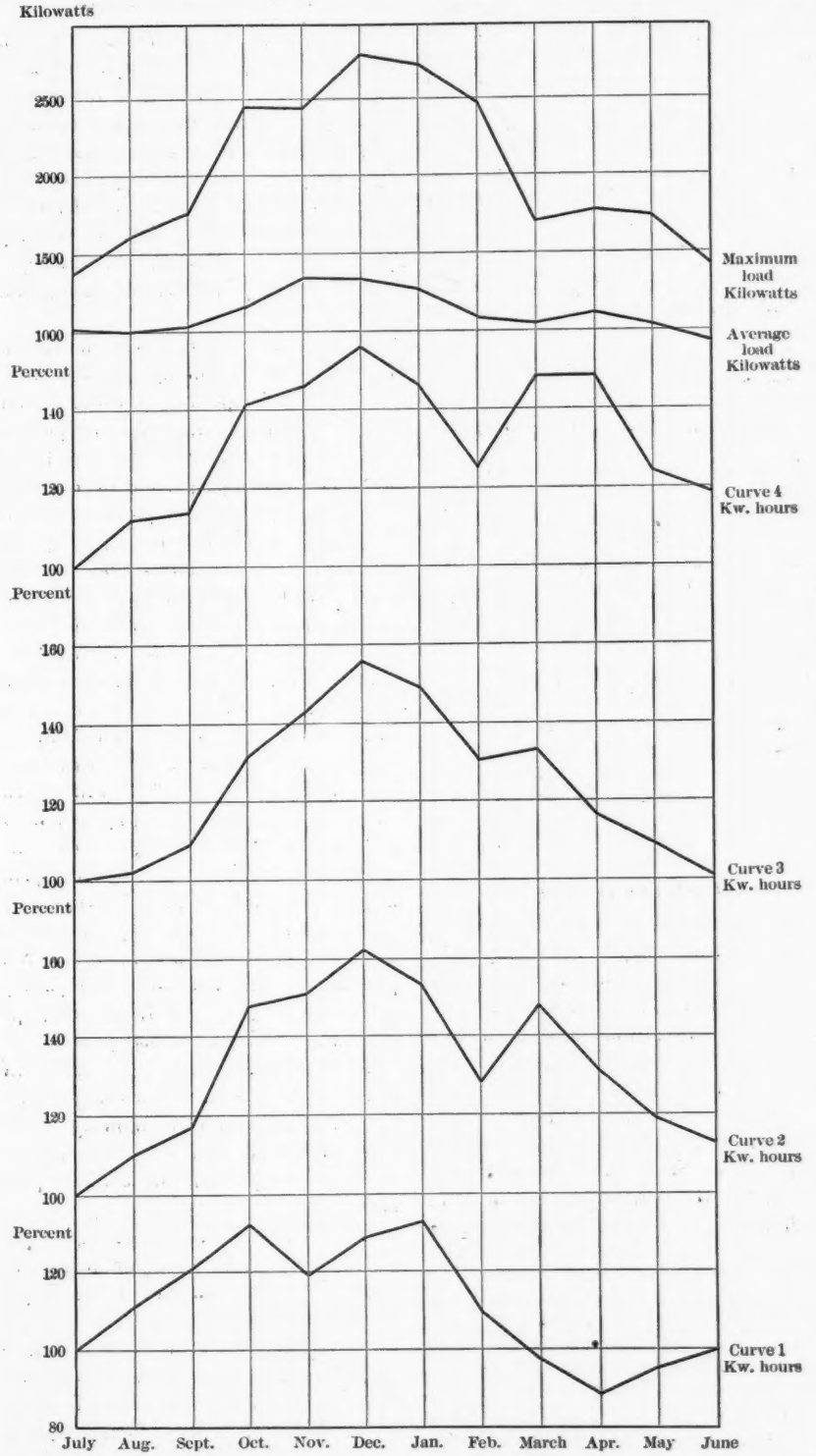
For Curve 1. Between 40,000 and 50,000 kilowatt hours in December.	For Curve 2. Between 200,000 and 250,000 kilowatt hours in December.	For Curve 3. Between 300,000 and 400,000 kilowatt hours in December.	For Curve 4. Between 800,000 and 900,000 kilowatt hours in December.
	For Curve 1.	For Curve 2.	For Curve 3.	For Curve 4.
July.....	100	100	100	100
August....	111	110	102	112
September..	121	117	109	114
October....	132	148	132	142
November..	119	151	143	146
December..	129	162	156	156
January....	133	153	149	146
February...	110	128	130	125
March.....	98	148	133	148
April.....	89	131	116	148
May.....	96	119	109	124
June.....	101	113	101	119

For the system under consideration the output of energy during June was about equal to that in August, the output during May to that of September, and the output during March to that of October. The system illustrated by curve 3 delivered between 300,000 and 400,000 kilowatt-hours during December. All lamps and motors connected to this system had a combined capacity of 3,323 kilowatts, of which 10 per cent was in street lamps, 24 per cent was in motors and 66 per cent was in commercial lamps.

During December the delivery of energy to these lamps and motors was greater by 56 per cent than the delivery in July. Outputs for May and September were nearly equal, as were also those of February, March and October. Connected load on the system represented by curve 3 was greater by 29 per cent than the load connected to the system of curve 2, but the number of kilowatt-hours delivered during December by the system of curve 3 was 54 per cent greater than the like delivery of the system represented by curve 2.

Explanation of these figures is found in the fact that the larger of these two systems had much of its load in retail stores, while the smaller system was devoted mostly to residence and street lighting and motor service. Between 800,000 and 900,000 kilowatt-hours were delivered during December by the system of which curve 4 represents the output.

The connected load of this system had a capacity of 8,212 kilowatts, of which 4 per cent was in street lamps, 54 per cent in commercial lamps and 42 per cent in motors. In December the output was 56 per cent greater than that of July.



CURVES SHOWING PERCENTAGES OF KILOWATTS DELIVERED BY FOUR LARGE SYSTEMS.

Deliveries of energy in the months of November, January, March and April were nearly equal to each other. For the system of curve 4 the connected load was 2.47 times as great as the load of the system represented by curve 3, and the

energy delivered during December to the larger load was 2.12 times the energy delivered to the smaller load. Both of these systems were favored with large lighting loads in retail stores, but motors made up only 24 per cent of the total connected capacity on the smaller system, while on the larger system motors formed 42 per cent of the capacity of connected load.

To the fact that demands of motors increase much less than the demands of lamps in December must be assigned the smaller ratio for kilowatt-hours than for connected loads.

On the system illustrated by curve 1, the average monthly delivery of energy during the year was 111 per cent of that in July, and 83.4 per cent of that in January.

The average energy output per month for the system to which curve 2 relates was 140 per cent of that in July, and 86.4 of the energy delivered during December.

For the system of curve 3 the kilowatt-hours delivered per month on an average were 123 per cent of the July and 78.8 per cent of the December output. Curve 4 illustrates a system where the average monthly output of energy was 131 per cent of the amount delivered during July, and 83.9 per cent of that delivered in December.

Comparing average with maximum, monthly outputs, the system with the largest percentage of street lamps stands highest, the two systems with largest percentages of motors come next, and the system with the largest percentage of commercial lamps shows the lowest ratio of average to maximum monthly delivery.

Platinum Supply.

There appears to be a likelihood of the world's platinum supply, which at present is almost stationary, while the demand is rapidly increasing, being enriched by contributions from both the United States and Canada. Hitherto, the chief source of supply has been the Ural Mountains, and the total yearly amount mined there is but a few tons. It is stated, however, that two other sources of supply have been discovered in the United States—one in Washington, N. J., and the other at the Olympia mine, on Kennedy Mountain. The ore from one of these districts has been assayed, with the result that it has been found to contain platinum in commercial quantities. Operations will probably be commenced in the early spring next year. It is also reported that discoveries of platinum have also been made in the Klondike by an expert of the Canadian Government, who detected the metal in considerable quantities in certain consignments of gold received from that region. Should these anticipations be realized, the supply of platinum may be very largely increased, which will naturally have the effect of lowering the present price of the metal, which is already higher than that of gold.

ON WHAT LINES SHALL WE REACH NEW BUSINESS TO IMPROVE OUR LOAD CURVE AND INCREASE OUR NET EARNINGS?*

BY GEORGE HAYLER, JR.

The problem under discussion may be treated from several standpoints, but I shall simply aim to make a few suggestions along a line that seems to me to offer a solution in the case of many small lighting properties. I am speaking more especially from the standpoint of stations operating from dusk to daylight and supplying light only, a condition which prevails in a large number of the smaller towns.

It is a notorious fact that the returns from the operation of lighting machinery are small in comparison with the possible output, and the average lighting plant is operated at a maximum efficiency for an extremely small proportion of the time.

The average lighting plant, under the conditions of which I have just spoken, will be in operation about 5,000 out of a total of 8,760 hours per year, or an average of about 417 hours per month. During the period that street lighting machinery will be in service (on a moonlight schedule) for an average of 188 hours per month, and I think that I am safe in saying that seventy-five per cent of the earnings from other lighting will accrue within a period not exceeding 160 hours per month on an average. In other words, the machinery of a lighting plant is practically idle so far as earnings are concerned for about seventy per cent of the time, and even when in service it is probably earning but little, and perhaps operating at a loss of from thirty per cent to fifty per cent of that period.

These conditions make it extremely difficult to show good net earnings unless the prices received from lighting are remarkably good, and in these days of severe gas competition this is a hard problem to face.

If now, we could so arrange as to operate our property in whole, or in part, for longer hours and dispose of the output, we should be nearer a solution. But, so far as lighting strictly is concerned, there is just about so much business to be done and no inducement will persuade people to use light when they do not need it. Further, it is practically impossible, in a small town, to develop a power load at prices that would make it profitable to operate a plant.

The only way out of the difficulty seems to be some other means of operating the lighting plant in connection with some other business, of such a nature that the electrical energy developed will be, in a measure, a by-product, and may be sold at a figure which will be attractive to customers who would, under ordinary circumstances, be entirely out of the question. A heating plant forms such an addition, and I shall endeavor to show you how it has worked out in our case.

If we examine into the operating expenses of a lighting concern, we shall find the costs divided pretty much as follows:

Fuel, twenty-two per cent; labor, twenty-nine per cent; water, three per cent; oil and waste, three per cent; carbons and lamps, four per cent; miscellaneous expenses, eleven per cent, *viz.*, insurance, repairs, maintenance, etc.; fixed charges, thirty per cent.

The large items are fuel, labor and fixed charges, and I think that it will be readily admitted that all, or part, of the mechinery of the plant could be kept in continuous operation at a slight additional expense other than for fuel, and this item would not be increased in proportion to the added output.

The average lighting property, operating under the conditions mentioned, is supplying electrical energy for only about fifty-seven per cent of the time; but we must not infer that our expenses will be proportionately increased if we should decide to operate for the balance of the twenty-four hours. The labor item will be increased perhaps fifteen per cent, fuel will be more, but a comparatively small amount, while the fixed charges will be increased by an amount covering interest on the investment in the heating plant. Other items may be increased a little, but may be neglected, being counterbalanced by savings made through the operation of the heating plant.

Roughly, from what experience we have had in the past few months on a heating load requiring about 100 horse-power, in freezing weather, the cost of fuel will be increased about fifty per cent; labor, fifteen per cent, and fixed charges, thirty per cent, a total increase of operating expense equal to about twenty-four and one-third per cent of the whole.

We will assume, for the time, that if we can obtain on an average about $80 per year per engine horse-power developed, we can show good net earnings. This is an arbitrary quantity and will vary according to conditions, and must not be taken as authoritative. Now if we can so arrange our business that we may dispose of an increased output at

*Paper read at the meeting of the Ohio Electric Light Association at Cleveland, Ohio, October 14, 15, 16.

somewhere near this figure, we shall add very materially to our net income.

When we use steam in an engine, under the conditions prevailing pretty generally in this section of the country, we obtain from ten to fifteen per cent of our heat energy in the form of power, the balance of eighty-five to ninety per cent being wasted in the exhaust, with the exception of perhaps about fifteen per cent, which may be absorbed in heating feed water. Now if we can dispose of this waste, it is evident that we can supply the balance represented by the amount of electric energy produced at a figure equivalent to the difference between what we receive for the waste and the amount that we find it profitable to sell our electric output for under ordinary conditions.

We find that hot-water radiation will give off about 246 B. T. U. per hour, with water at 200 degrees Fahrenheit, which will be the temperature required in severe weather, or about 155 B. T. U. with water at 160 degrees, which represents ordinary working conditions; and allowing for losses, etc., one engine horse-power of exhaust steam will supply, approximately, 120 feet of radiation in extreme weather; or about 192 feet under ordinary working conditions. Now, at the figure received for heating in this section, the income from one engine horse-power will be $18 per year under extreme conditions, and about $28.90 under ordinary working conditions.

We have seen that the cost of operating our steam plant will be increased about twenty-five per cent. In other words, we may obtain on a load of 100 horse-power, bringing an income of $28.80 per year at an output of about twenty-five per cent of our total operating expense, and have the electric energy produced at the same time to sell at a figure equivalent to the difference between what we receive for the heat and what we ordinarily get. For example: If we have a heating load of 20,000 square feet of radiation, requiring approximately 100 horse-power under ordinary conditions, and bringing in an income of $3,000 per year, then assuming that we are to receive the same rate for horse-power developed ($80 on the average), we can dispose of our electrical output at the rate of about $50 per horse-power per year, and at the same time increase our net earnings 100 per cent on each 100 horse-power of our steam equipment.

Understand, I have assumed ordinary working conditions. It is true that in severe weather 100 horse-power of exhaust will not supply 20,000 feet of radiation, and we shall have to use live steam at a consequent increase of operating expenses; but the number of days that this condition will prevail is comparatively small.

It is evident, however, that at the figure quoted, the income from heating alone is but a little more than the additional expense incurred in operating the plant during the entire year. If we simply furnish live steam in cold weather and do not operate our lighting plant, we shall still be making a profit, for the reason that during the winter months there is a supply of exhaust steam available for about two-thirds of the time. It is evident, however, that the solution of the problem is to operate the entire plant and increase the output of electric energy during the day, so that we may be deriving income from two sources. What I mean is this: If we can sell our heat for $30 per horse-power per year, and utilize eighty-five per cent of our heat energy, and make a profit, then we can certainly increase that profit very considerably by setting the balance of fifteen per cent of our heat energy in the form of electricity, at the rate of, say, $50 per horse-power developed per year, or even less.

It may be argued that it will be difficult to dispose of the electric energy developed in a small town, but there is always some demand, and, with the proper inducement in the way of prices which we are enabled to make under the circumstances, there is no reason why such a load should not be developed.

Assuming that we can deliver sixty per cent of our engine output in the form of electrical energy to the customer and make a profit at $80 per engine horse-power developed per year, then we can sell electric energy for about $30 per horse-power per year, an amount favorably comparable with the cost of steam power in a small plant.

The Practical Working of Rotary Converters.

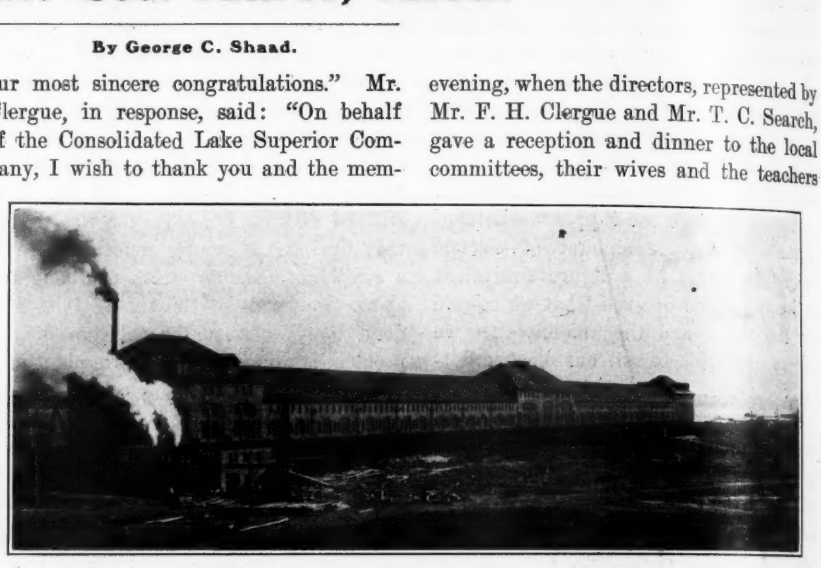
The main object of this article, in a recent number of a British contemporary, by Mr. J. R. Salter is to demonstrate the flexibility of the rotary converter when employed in a combined alternating-current and continuous-current station. The use of the rotary to convert from alternating to direct currents is not unusual, but there appears to have been some doubt as to its successful operation when converting from direct to alternating current. The author has adopted this arrangement and has found it so successful that it has been determined to increase this use of the machine. The plant in which this arrangement is adopted consists of two direct-current, 500-kilowatt, compound-wound generators and one 5,000-volt, 25-cycle alternator, together with the rotary converter. The converter has been used for running as a direct-current generator in parallel with one of the direct-current sets, being driven by a three-phase alternator, or for generating current in the event of the alternator being shut down; and, further, for running in parallel with the alternator in times of excessive load on the substation. The machine has a capacity of 250 kilowatts, the voltage on the alternator side being 330. On the direct-current side it is compounded for 500 and 550 volts. At one end of the shaft there is coupled an induction motor for starting, though when the machine is running as an inverted converter it is easily started from the direct-current side. At the other end of the converter there is a booster mounted directly on the shaft, this booster being in circuit with one of the feeders. The starting motor has a smaller number of poles than the rotary, and synchronism is effected by loading down one phase of the converter. When the machine is running parallel with the direct-current units, it takes up the greater part of the load, as its compounding is greater than that of the direct-current machines. When the converter is supplied with direct current, and delivers alternating current, the speed is no longer constant. To overcome the unstability in speed, the rotary is excited by means of a small generator direct-connected to an induction motor which in turn is driven by the rotary itself. The rotary has been run frequently under these conditions and with very satisfactory results. On the alternating side it was connected to the low-tension side of the transformers in the generating station. At the substation the direct current was transformed down by means of a second rotary converter. The system is capable of working twenty cars without hunting, and also of working in parallel with a second rotary substation operated by the main three-phase generator. For starting the motor as a direct-current motor, the series coils were cut out and the machine run as a shunt-wound motor. It was found, when operated as a shunt motor, working in parallel with the alternator, supplying the same feeders, the rotary frequently fell out of step. On reversing the series coils, the rotary kept perfectly in step. Regulation is effected through the series coils.

The Opening of the Hydraulic Power Plant of the Consolidated Lake Superior Company at Sault Ste. Marie, Mich.

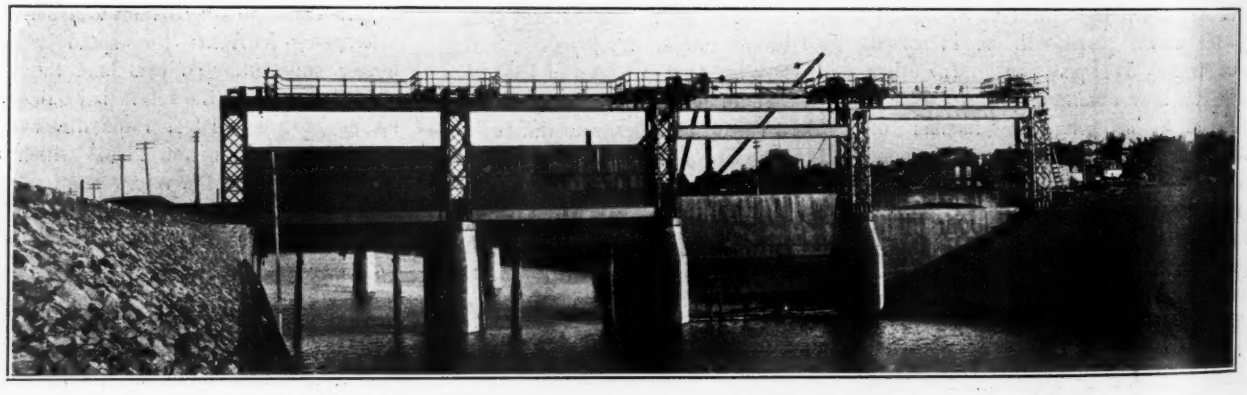
By George C. Shaad.

THE opening of this, one of the greatest hydraulic power developments in existence, was the occasion of a grand celebration in Sault Ste. Marie, and visitors flocked to the city in thousands from all parts of the surrounding country. A preliminary test of the generators installed was made on Friday afternoon in the presence of Mr. D. O. Sessions, engineer in charge of the Stanley Electric Company's installation, and his assistants. All was found to work satisfactory and to be ready for the formal opening to take place the next day. At 12 o'clock noon, Saturday, October 25, the fourth anniversary of the granting of the contract for the construction of the canal and power-house, the water was turned on the first generator, and soon after power from this machine was utilized in running the first street car of the Sault Ste. Marie Traction Company.

The opening ceremonies were held on a platform erected in front of the power-house and were very brief. Mr. H. von Schon, chief engineer in charge of the power canal construction, turned the plant over to the Consolidated Lake Superior Company, addressing Mr. F. H. Clergue and about fifteen other members of the company, as follows: "On behalf of the members of the engineering corps I take great pleasure in turning over to you and to the members of the Consolidated Lake Superior Company this great canal. It has been constructed, I think, in a most perfect manner; the greatest difficulties have been surmounted, and I think that we are turning over to you a perfect piece of engineering. The engineering corps extend to the company our most sincere congratulations." Mr. Clergue, in response, said: "On behalf of the Consolidated Lake Superior Company, I wish to thank you and the members of your staff for your faithful and, we believe, perfect work. Now that the canal passes out of your hands, and you may seek more profitable occupations, for perhaps this has not always been so, you will always have with you our best wishes for success. We appreciate the difficulties which you have surmounted and trust that you will surmount others as you have these." He then asked Miss Helen Clergue to throw the switch which was to set the turbines in motion. Lights had been placed around the stand, and these quickly responded to the throwing of the switch. After this the power-house was thrown open for inspection and was visited by thousands. The Consolidated company served refreshments to the visitors, the entire second floor of the power-house being utilized as a dining hall for this purpose.



POWER-HOUSE OF THE CONSOLIDATED LAKE SUPERIOR COMPANY, SAULT STE. MARIE.

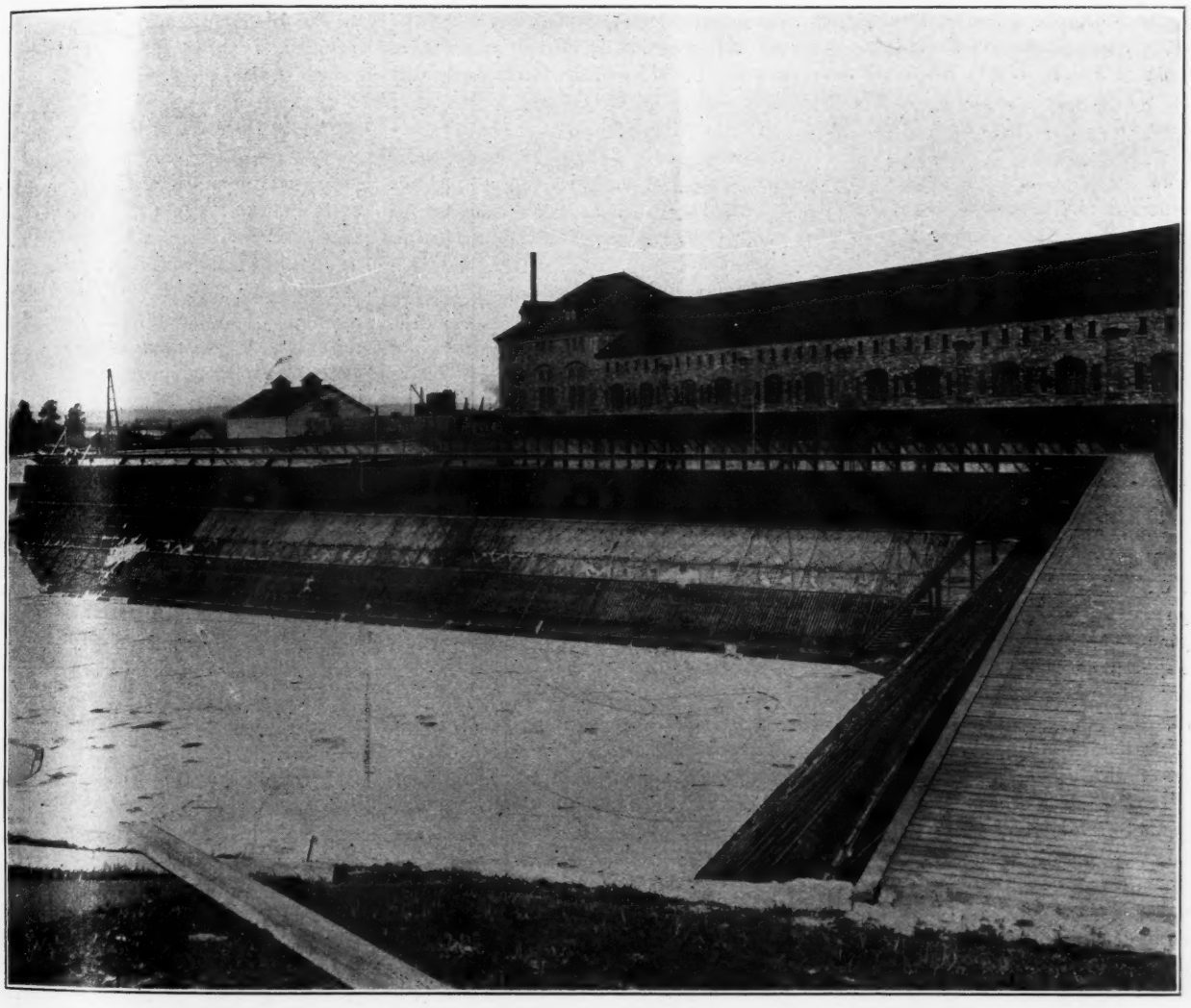


HEADGATE OR MOVABLE DAM, CONSOLIDATED LAKE SUPERIOR COMPANY, SAULT STE. MARIE, MICH.

The celebration started Thursday evening, when the directors, represented by Mr. F. H. Clergue and Mr. T. C. Search, gave a reception and dinner to the local committees, their wives and the teachers in the public schools, at the Iroquois Hotel. About 300 guests were present. Friday afternoon 3,000 school children marched in parade, and later assembled at the power-house, where a dinner was served to them and addresses made by Judge W. M. Snell and other prominent speakers. The reception and ball given in honor of the citizens of the two "Soos," Friday evening, were the most brilliant affairs ever held in the city. The armory was filled to overflowing. Mrs. and Miss H. von Schon led the grand march. Near the door was located a model of the turbines at the power plant enclosed in a glass case, so that the operation could be readily inspected. The power developed was used to drive a set of movable decorations. On the opposite side of the armory there was a reproduction of the power plant as it will appear when fully completed and illuminated.

Saturday was given up to parades. A

civic parade was held in the forenoon and, following the ceremony at the power-house, an industrial and historical parade and also a naval parade took place. The historical parade was headed by a band of Indians, the first inhabitants of the "Soo," followed by trappers and hunters of the Hudson Bay Company, and various floats representing the water-power development in its different stages, various industries, etc. At the end rode several prominent citizens of Sault Ste. Marie.



FOREBAY, SHOWING CONSTRUCTION AND POSITION OF ICE RACKS, CONSOLIDATED LAKE SUPERIOR COMPANY, SAULT STE. MARIE.

A banquet was given to the prominent men of the city and guests of the Consolidated company, Saturday evening, in the armory. About three hundred were present. Mr. Clergue acted as toastmaster. He spoke to some extent regarding the power that may be obtained from the new power plant and power stored in the Great Lakes and St. Lawrence River taken as a whole system. He predicted that inside of twenty years no coal will be used in the state of Michigan or along certain portions of the St. Lawrence River for traction or power. After thanking the citizens of the city for their aid in securing the rights of way for the canal, he proposed the toast, "Health and prosperity to the citizens of Sault Ste. Marie." Mr. J. S. Osmond, railway commissioner of the state of Michigan, responded. Mr. J. I. Tarte, former minister of marine in Canada, spoke of the undeveloped resources of the Dominion and the relation existing between the "United States of Canada" and our own country. Governor Bridge delivered an address, "The State of Michigan." Mr. E. V. Douglass, president of the Michigan, Lake Superior Power Company was unable to attend the banquet on account of illness.

Sunday morning appropriate services were held in the churches, and in the afternoon a praise and thanksgiving service in the power-house was very largely attended.

It is estimated that the Consolidated Lake Superior Company spent between $30,000 and $50,000 for this celebration. A street car was sent from St. Louis by express so that it would be in the city by Saturday. Fully 25,000 people visited the city.

The Stanley Electric Manufacturing Company was represented by Dr. Perrine, president of the company, and Messrs. C. C. Chesney, D. O. Sessions and Ray D. Lillibridge. As prominent guests of the company may be mentioned the following:

Philadelphia—J. Bell Austin, secretary and treasurer Philadelphia Stock Exchange; William P. Bement, James Butterworth, H. W. Butterworth Sons' Company; James M. W. Cardeza, director First National Bank; Waldo M. Claflin, Samuel H. Cramp, W. P. Douglas, secretary Consolidated Lake Superior Company; Edward S. Dunn, treasurer Philadelphia Warehouse Company; J. R. Erringer, Jr., division ticket agent, Pennsylvania Railroad Company; J. F. Fahne-

stock, assistant treasurer International Navigation Company; Geo. A. Fletcher, Mitchell, Fletcher & Company; Aaron Fries, Isaac Hough, Isaac Hough & Company; William P. Huston, A. R. Kraemer, Ervin & Company; W. B. Kurtz, W. W. Kurtz & Company; S. L. Levy, Levy & Lewis; Horatio G. Lloyd, Jr., vice-president Commercial Trust Company; J. R. McAllister, cashier Franklin National Bank; F. D. McLain, *Philadelphia Inquirer;* John H. McQuillen, John H. McQuillen & Company; David B. Martin, William P. North, treasurer Real Estate Trust Company; Samuel L. Shober, Jr., Charles A. Sparks, Henry Whelen, Townsend Whelen & Company; Joseph W. Wilson, Wilson & Crawford; Owen Osborne.

New York—Charles E. Orvis, Orvis Brothers & Company; Elwood Hendrick, Pomroy Brothers; Alfred P. Boller, Boller & Hodge.

Other points—Charles Watson, Camden, N. J.; George P. Brook, cashier Doylestown National Bank.

THE POWER PLANT.

The accompanying illustrations show the general appearance of the power-house and give some idea of its extent. The Sault rapids are about half a mile long and half a mile wide, and are formed by a sandstone ledge over which the waters of Lake Superior discharge into Lake Huron and are capable of developing from 130,000 to 260,000 horse-power, depending on the relative evaporation and precipitation. The power plant is located below the rapids, and its substructure forms the dam proper. The water is led to it by means of an immense canal, the inlet of which is on Lake Superior above the rapids. The contracts for the construction of this great waterway were let to H. W. Hubbell & Company, West Bay City, Mich., for the intake; E. D. Smith Company, Philadelphia, for the canal, and the Mason & Hodge Company for the construction of the power-house and the forebay.

The intake is 950 feet wide at the entrance and rapidly narrows to a width of 250 feet at a point 1,000 feet from the entrance, continuing at this width to the head gates placed at the entrance to the canal. These gates are composed of four steel sections, each forty-eight feet by twenty-six feet, and supported by massive piers of masonry. They are used for shutting off the water supply to the canal in case it is necessary to do so. The distance from here to the forebay is about 13,000 feet and has a width of 214 feet at the water line and a uniform depth of twenty-three feet when supplying full power. When the canal passes through rock the sides are chiseled down or filled in so as to present a smooth surface to the flow of the water. Through sand and clay the bed and sides are lined with plank laid on timber seamed by means of piles. The timber lining extends to just below the water line, and from here the sides are built up of masonry laid with a slope of one in one. Through sand the canal is 104 feet wide at the bottom and 214 feet wide at the top, while through clay the section becomes more nearly elliptical, the sides consisting of three different slopes. The sides of the forebay are built with a slope of one in one. The entire waterway is built to give the least possible resistance to the flow of water and to be permanent. When delivering full power the canal will furnish 30,000 cubic feet of water every second, and the maximum rate of flow will be about one and one-half miles an hour. The canal is capable of supplying 57,000 horse-power when the water supply from Lake Superior is a minimum.

The power-house is 1,368 feet long, 100 feet wide and 125 feet high, and is built of sandstone taken from part of the canal. A foundation is formed by driving piles through the clay to solid rock, and on top of these is laid a mass of concrete three feet thick. Over 12,000 fifty-foot piles were used for this purpose. The floors are built of concrete and the roof is galvanized iron. The substructure which carries the water to the river below the power-house consists of eighty-one chambers 100 feet long and 20 feet high, separated by masonry walls three feet thick. On top of these pits is the penstock structure, consisting also of eighty-one sections, each forty-five feet long, fifteen feet wide and thirty feet high, separated by steel and concrete partitions. These sections are closed on the down-stream side by semi-circular bulkheads open on top and contain the hydraulic units. The part of the building directly above the pits and not occupied by the penstocks will be utilized for the generators and high-tension transformers. Above the penstocks are two floors, each extending the entire length and breadth of the building. Over one-half of this space will be occupied by the Union Carbide Company.

Each hydraulic unit consists of four 35-inch new American turbines mounted in two pairs of two each on one shaft. This shaft pierces the bulkhead of the penstock structure and is to be direct-connected to a 400-kilowatt generator. Each set of turbines is capable of developing 570 horse-power under a head of sixteen feet, with an efficiency varying between eighty-one and eighty-three per cent.

At the time of opening, one single-phase, 60-cycle, 400-kilowatt, 2,400-volt Westinghouse alternator, and one of the Stanley Electric Company's 400-kilowatt, 3-phase, 30-cycle, 2,400-volt generator, together with a 50-kilowatt exciter belted to the Westinghouse generator and a 400-kilowatt, 600-volt rotary converter, built by the Stanley Electric Company, were installed. Three 130-kilowatt water-cooled transformers stepped the voltage down from 2,400 volts as generated to 370 volts for the rotary converter. This converter and the exciter are temporarily installed for the use of the street railway until the regular apparatus is in place. When fully completed the electrical equipment will consist of thirty-three 400-kilowatt, 3-phase, 2,400-volt revolving field type alternators running at 180 revolutions per minute; four 400-kilowatt, 600-volt, compound-wound, direct-current generators being supplied by the Stanley Electric Company; one 400-kilowatt, single-phase, 60-cycle, 2,400-volt alternators; forty-two 400-kilowatt, 60-cycle, single-phase, 90-volt generators, all revolving field type, and two 400-kilowatt, 220-volt, direct-current machines of the Westinghouse Electric Company's make. A storage battery will be used in connection with the exciters which will be driven by synchronous motors. The transformers stepping the voltage from 2,400 volts up to 16,200 volts for the transmission line will be of the Stanley make, 400-kilowatt units, water-cooled. The ninety-volt generators are for the use of the Union Carbide Company. The 600-volt, direct-current machines will be used for the street railway and will be supplemented by rotary converters as the demand for direct current in the vicinity of the power-house increases. The Stanley generators, both alternating and direct current, will be regulated by Lombard governors, actuated by oil pressure, of 150 pounds per square inch, pressure being supplied by two sets of motor-driven pumps.

The controlling apparatus for operating the switching devices and turbines, as well as the indicating instruments, will be mounted on three sides of a room about twelve feet square, the switches themselves being worked by electromagnets or motors.

Several of the generators are at the plant, and the work of installation will

be pushed as rapidly as possible. A steam plant located in one end of the buildings has been used for pumps and will furnish heat for the building. Two 15-ton electric cranes, manufactured by Pawling & Harnishfeger, of Milwaukee, travel the entire length of the generator room and are used for installing the apparatus and making repairs. Mr. D. F. Thomas is chief electrician of the power company.

The first commercial user of power generated at this plant is the Sault Ste. Marie Traction Company. The first car was started soon after the opening exercise, and many took advantage of the passes very liberally bestowed by the company. The Falk Manufacturing Company, of Milwaukee, Wis., has the contract for the track and line construction, and the lines within the city are nearly completed. The road will be extended to the prominent suburbs next year. No. 00 trolley wire, supported by three-eighths-inch galvanized span wire from painted cedar poles, is used throughout the system. Rails weighing eighty pounds to the yard, laid on cedar ties in crushed rock, are used in the track construction. The road is to be equipped at once with six semi-convertible double-truck cars, vestibuled at both ends, manufactured by the St. Louis Car Company. Westinghouse motors and controllers will be used on these cars. The Taunton Locomotive Manufacturing Company, of Taunton, Mass., is furnishing a powerful snow-plow, while a sweeper is to be purchased from the McGuire Manufacturing Company, of Chicago. The sweeper will be equipped with General Electric Company apparatus.

Power will be transmitted at 15,000 volts to manufacturing plants along the canal and Hay Lake. Sixty-foot Idaho white cedar poles, spaced ninety feet apart, are used for the transmission line, the conductors consisting of No. 00 hard-drawn copper wire mounted on Locke No. 3 insulators. The lines pass through the walls of the power-house to the transformers in six-inch porcelain tubes. The electric power, aside from that of the Union Carbide Company, is controlled by the Michigan-Lake Superior Power Company. Complete details of the electrical equipment, as it will be when entirely installed, can not be obtained at this date. The power company expects to sell all the power it will be able to generate in a short time, and it is believed that Sault Ste. Marie will soon be one of the greatest manufacturing towns in the country.

THE TURBINES IN POSITION, CONSOLIDATED LAKE SUPERIOR COMPANY, SAULT STE. MARIE.

Book Review.

"La Télégraphie Sans Fil, Son État Actuel et ses Chances D'Avenir, D'Après les Essais Transatlantiques de Marconi." Berne. Office Polytechnique d'Edition et de Publicité. Paper. 65 pages. 4¾ by 7¼ inches. Furnished by the ELECTRICAL REVIEW at 50 cents.

This little book traces the progress of wireless telegraphy in the last few years, and predicts for it complete commercial success. The various methods now in use are discussed, and the apparatus employed by each inventor described with some detail. A list of the patents which have been taken out in this and foreign countries is given. The subject is taken up logically, discussing the distance and velocity of transmission obtainable, the perfection of the various apparatus, and the elimination of atmospheric disturbances. Applications to meteorological work and commercial service are touched upon. The latter part of the book is devoted to the discussion of Marconi's transatlantic experiments, and the ultimate success of this system of transmitting intelligence to great distances is held to be assured.

Joint Telephone Convention.

Independents from Kentucky and Indiana Hold Their Annual Gathering in Louisville, Ky.

ONE hundred and twenty-five delegates, representing twenty-eight telephone companies in Kentucky and about half that number of Indiana corporations, assembled at Exchange Hall, Board of Trade Building, on the morning of Tuesday, October 28, for the opening session of the Kentucky and Indiana independent telephone associations. The joint session was the fourth assembly of the Kentucky Independent Telephone Association, and the third of the Southern Indiana Independent Telephone Association. The meeting was called to order by Mr. R. V. Bishop, of Cynthiana, Ky., the president of the Kentucky association. With him on the platform was Mr. G. A. Keinle, of Huntingburg, Ind., president of the Indiana association.

The address of welcome was delivered by City Attorney Henry L. Stone, representing Mayor Grainger, who was absent from the city. Mr. Stone tendered a hearty welcome to the delegates to make the best of the city's possibilities, and welcomed the increasing power of the independent movement.

Colonel W. C. P. Breckenridge, of Lexington, Ky., was to have responded on behalf of the Kentucky association, but was detained by legal business. The response was therefore delivered by Mr. H. K. Cole, vice-president of the Kentucky association.

Mr. G. A. Keinle responded on behalf of the Indiana delegates. He stated that the Indiana delegates were at first in favor of having the joint convention at Evansville, Ind., but they had been unable to resist the allurements held out by their hosts of Louisville. Kentucky and Indiana, he said, were more than sister states, especially in the matter of better and cheaper telephone service. He exhorted the members present to promulgate their best ideas to the betterment of the independent telephone movement in general.

The first paper of the afternoon was read by Mr. S. P. Sheerin, of Indianapolis, who has for some time taken a prominent part in the work done by the Litigation Committee of the national association of independent telephone companies. Mr. Sheerin gave a comprehensive report of the contest which has been going on between the older company and the independent organizations with regard to the various patents involved. He called attention to the fact that the members of this committee had conducted their labors without pay, and that they are already personally liable for about $12,000 in costs, etc. In order to meet this and to raise a further sum of $12,000, it has been decided to assess each state association. Kentucky's share, he stated, will be $10,000, and Indiana's, $2,000. On motion, Mr. Bishop, D. L. Prewitt, J. L. Brailey and John A. Armstrong were appointed a committee to plan the assessments and report at the Wednesday business session.

Mr. D. L. Pendleton, of Winchester, Ky., read a paper on "Rates," presenting some very strong arguments for the adoption of uniform rates by the independent companies as soon as possible. The discussion of this paper was referred to the business session of Wednesday.

Mr. H. K. Cole read a paper, entitled "Long-Distance Toll Lines and Connections." This paper was supplemented by a report from Mr. J. L. Brailey, who has charge of the independent long-distance system being constructed out of Louisville. Mr. Brailey reported that long-distance connections with Lexington, Frankfort and the entire Bluegrass region would be in operation by Sunday, November 2. The long-distance lines to Elizabethtown and the southern part of the state are already in operation. The lines to Owensboro, Henderson and Weston would be in operation within ten days' time. The report was received with great applause by the delegates.

Mr. E. M. Coleman, secretary of the Louisville Home Telephone Company, and secretary also of the Interstate Telephone Association, made a report as to the progress of the big association which was organized in Chicago last April.

Mr. A. J. Payton, Rockport, Ind., was to have read a paper on "The Bell People as Antagonists," but was prevented from being present. The paper, entitled "Franchises," by Colonel John R. Allen, of Lexington, was also left unread, the author not being present. At the conclusion of Mr. Coleman's paper, it was announced that a smoker would be held at the Louisville Hotel on Tuesday evening. An invitation was also extended to the delegates to attend a banquet to be given Wednesday evening at Fountain Ferry Park by James S. Clark, Jr., the Louisville electrical manufacturer, special cars to the park being supplied by the company.

The smoker in the evening was a most enjoyable affair. In addition to the delegates, a number of Louisville, New Albany and Jeffersonville business men were present as invited guests. When the guests had assembled, Mr. R. V. Bishop announced that every man called upon would be obliged to respond with a story. A number of good anecdotes were thus brought out, and among the speakers were President Bishop, President Keinle, Mr. Desha Breckenridge, of Lexington; Mr. David Bush, of Winchester; Mr. R. E. Ashbrook, of Paducah, and Mr. Jacob Zinsmeister, of New Albany.

The second and closing day of the convention was a busy one for both associations. While the papers were read to joint sessions, the executive business was conducted at special meetings held by the associations on Wednesday afternoon at the Louisville Home Telephone Company's building. The joint assembly Wednesday morning was opened by the reading of a paper by Mr. A. L. Tetu, of Louisville, on "Operating and Governing Telephone Plants." This paper was a review of the practical problems of exchange management.

An interesting address, dealing with the future of the independent telephone movement, was delivered by Mr. J. L. Brailey, of Toledo, Ohio. The title of Mr. Brailey's paper was "Merging of Independent Telephone Plants." He called attention to the fact that the companies are dependent on each other, and stated that the establishment of long-distance connections is hastening the time when all the companies will become parts of state and national organizations.

Each of the associations then went into executive session for the election of officers. Mr. John A. Armstrong was nominated for president of the Kentucky association, but declined. Mr. D. L. Pendleton, of Winchester, was then nominated and unanimously elected. All the other officers of the association were re-elected, as follows: Mr. H. K. Cole, Lancaster, vice-president; James Maret, Mount Vernon, Ky., secretary and treasurer.

The Indiana association reelected all the old officers, as follows: J. A. Keinle,

Huntingburg, president; C. D. Knofel, New Albany, vice-president; E. W. Pickhardt, Huntingburg, secretary; T. N. Thom, Lamar, treasurer.

After the elections, retiring President Bishop read a report of the year's work done by the Kentucky association. The report showed that the capital invested in independent telephone exchanges has increased 100 per cent. The increase in toll-line mileage has been seventy per cent. The increase in subscribers was 145 per cent.

Questions of internal economy were discussed by the associations at Wednesday afternoon's business sessions. At the Kentucky meeting, an executive committee was appointed to take immediate action in the matter of uniform rates. This committee will confer with the Indiana committee.

At the business session of the Southern Indiana Association it was decided to raise the membership dues from $1 to $3. Manufacturers' dues were reduced from $10 to $5. A resolution was adopted, thanking the people of Louisville, the members of the Kentucky association, the officers of the Louisville Home Telephone Company and James S. Clark, Jr., for the hospitable treatment accorded the visitors.

The entertainment tendered the delegates by Mr. Clark was greatly enjoyed, about eighty of the 100 or more delegates remaining in the city after the convention adjourned to accept this firm's invitation to a banquet. There was plenty of music and a number of impromptu toasts, and those delegates who were the guests of this Louisville firm had no occasion to regret their decision.

The Telephone in New York.

In his address on "The Future of the Telephone in the United Kingdom," read before the British Association for the Advancement of Science, Mr. J. E. Kingsbury spoke as follows of the New York Telephone Company:

"It is sometimes assumed that competition is necessary in order to increase the number of subscribers. I will give an example of phenomenal increase without competition. On January 1, 1894, there were about 10,000 stations in New York. On January 1, 1902, there were 72,189 stations in only a portion of the area which was included in the 1894 figures. This considerable increase over the previous progress is attributed to the adoption of a rational system of charging. Up to 1894 there was a 'flat rate,' the same subscription for large user and small user. In 1894 the message rate system was applied, with the result that the telephone service has become available to the small user and enormously increased in value to all subscribers by widening the field of communication. This method has also been adopted for the Post-Office system in London. It was proposed for adoption some years ago by the National company in Sheffield, but the subscribers rebelled against it."

There are now over 100,000 telephones in use in the territory of the New York Telephone Company, and there is a constant increase in the number of users.

Distribution of Energy for Tramway Lighting and Power Purposes.

In a recent article in *Engineering* (London) Mr. E. T. Williams considers the adoption of various systems of distributing power for the following case: A company holding powers for electric railways and lighting in three villages. The station is to be placed at a central point, close to a coal mine and canal. The longest line of railway is six miles, and a good demand for power and for lighting is expected. The first system considered is a high-tension, continuous-current and rotary transformer system, the advantages claimed being uniformity of system, no light load and idle-current losses, the possibility of controlling all substations from a central switching station; steadier pressure may be obtained, as well as higher efficiency, than in other systems; the transformation of pressure and current is accomplished in one machine. The disadvantages of this system are its highly complicated parts, its risk of breakdown due to the number of pilot wires running between substations, commutator troubles are usual, and there is a great strain on the cables on opening switches, and due to short-circuits. In the author's opinion, this system is not suitable. The low tension, with reversible boosters and battery substations, has the following disadvantages: There is a greater weight of copper required in the mains, the copper loss in the mains is greater, as well as loss due to batteries, than that of other systems. The particular case considered here assumes two sets of batteries at each of the three substations, one carrying the lighting load and the other power load. The use of the reversible booster here avoids the expense and the complications arising from the adoption of regulating cells. The cost of such booster and its appliances is less than that of the extra regulating cell, the battery leads and switches. The engine may be worked at a steady and economical load throughout the day, the batteries taking the sudden peaks and carrying the light load throughout the night. The battery charge is only what might be called the surplus power, and only a percentage of the whole current is accumulated. In other systems all the power has to be transformed or converted. This system has six batteries, any number of which may be used for lighting or traction. Against a heavy capital cost of the battery stations may be placed a lower capital cost of the power station. Three-phase alternating systems are next considered, the chief advantages being the comparatively small amount of copper required for mains, the high voltages that can be satisfactorily used, simplicity in generation and less expensive switch gear. Under this head there are four methods of transforming and converting. When the load is principally or altogether a power load, a polyphase motor will meet the requirements of each consumer, and a static transformer is the cheapest, simplest and most economical system. Lighting, however, on this system with motor loads is not satisfactory. An asynchronous motor-generator is simple, and there is an absence of complicated switch gear. The efficiency, however, is not high, and the power-factor is low. The comparative cost of the substation equipment is higher than with the synchronous motor-generator or rotary converter. The synchronous motor-generator is more complicated than the previous type, owing to the starting gear and synchronizing operations and the necessary exciters. These machines will work with a high periodicity, and for combined lighting and power work are very satisfactory. The power-factor of the system is high, the efficiency is better than with the asynchronous machine, and the cost is less. An important point is the ease of controlling current and pressure of the direct-current generators at the substation. The rotary-converter system is the most complicated of all. The disadvantages are: It will not work satisfactorily, high periodicity, and there is trouble in preventing hunting; there is some difficulty in operating the machines in parallel. The advantages are: High efficiency, the high overload capacity and the low cost. If the amount of power work is great, and the lighting load small, rotary converters are usually desirable. In conclusion, the author decides that either the low-tension system with reversible boosters and battery substations, or the three-phase synchronous motor-generator system should be used. Before a final decision can be made, further particulars of the locality would have to be known.

Machine Tool Progress—III.

By Charles E. Hadley.

ONE of the recent developments in the milling line to kill filing or troublesome setting of the work is the Universal machine made by Van Norman, in Springfield, Mass., wherein the cutter spindle has an angular adjustment in the vertical plane of the spindle axis. It saves angular cutters and is much appreciated by die-sinkers.

Machinists are gradually becoming educated to the use of the milling machine in cuts that were formerly taken on a shaper, and while that valuable tool still has plenty of field for work it has largely ceased to nibble at cuts which belong of right to the milling machine. But to make the latter entirely successful as a substitute, a good assortment of cutters should be carried and should be kept sharp. Cutter grinders, therefore, are necessary companions, as a milling machine without a cutter grinder reasonably accessible would be about as effective in operation as a cat without claws.

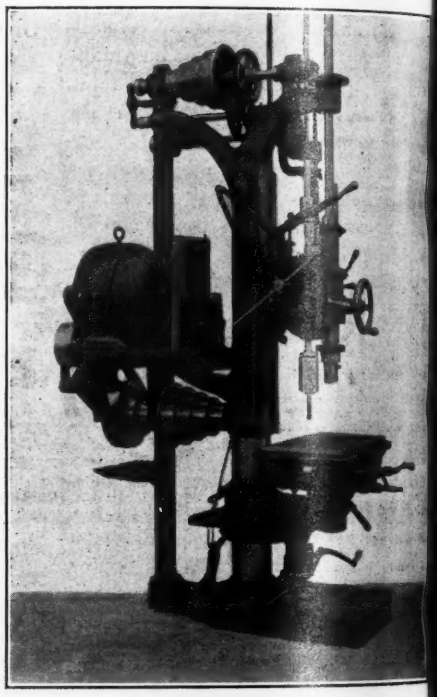
Then, with sharp cutters, the machine, if good and heavy, is a power for economy. It required a long time to adapt the milling machine to long and heavy cuts, because it soon acquired the reputation of doing uneven work, especially when cuts of variable cross-section were taken. The trouble was chargeable largely, however, to the commonest source of the worst trouble in machine tools—that is, lack of or improper distribution of metal in beds and frames. A milling machine, above all tools, on account of the stress radially put upon the cutting spindle, requires a large, well-journaled spindle and a generous mass of metal in table, knee and column.

With the stiffening of structures came the long and heavy cuts and, working to the same end as the lathe development, it became of great capacity as a remover of metal and not limited by torsional strength of the piece operated upon. In the majority of cases the rapidity of stock reduction is greatest in this class of machines.

The corollary of cutters has been and is an important art in itself, and the variations are endless. First we had in the old Lincoln type finely spaced shallow-toothed, cylindrical mills which filled with the fine needle-like chips when working under oil on steel looked like a rolling-pin and after one or two grindings the illusion was complete. An inch a minute was record time then, and some time ago, now, I was shown a spline some three-eighths inch wide and one-quarter inch deep which, if I remember, had been cut at the rate of nineteen inches per minute. Then there were the terrors of the form cutter, each tooth laboriously backed off by hand with a file, when Brown & Sharpe came to the front with their system of gear cutters, whose principle also applied to form cutters, and in which the sharpening on the face of the cutting teeth did not alter the form.

Cutters grew to enormous diameters and the difficulty of hardening inspired the inserted tooth mill, which design solves the problem of cheap, large cutters, the lack of which, for a long period, stunted the growth of the milling machine. With the successful development of a system for producing large mills economically came the various designs of the heavier types of machines. Double-head machines, machines with long planer-like tables with vertical and horizontal cutter spindles to operate on work as large as locomotive frames, and to sweep the whole surface V's and all of a large lathe bed at one cut.

The gear cutting machine, an important member of the milling machine, or, rather, the planer family, has shown some very peculiar moves in the process of development. One of the earliest forms of milling machine it did good service for years on was external spur gears and until a few years ago the hand machine with the drilled dial was the only type. Internal spur gears were cut on the shaper or splining machine, another member of the planer group, and bevel gears were shunned as an imperfect mechanical motion. In heavy shafting gearing they were cast, which, barring the roughness, were the most nearly correct, as the pattern-maker could manage to gauge his lines to a straight edge pivoted at the cone apex, and get what the cutter could not produce, but bevel gears with finished teeth had to be used in many cases, and they were trimmed and filed into shape after a fashion. Then a resort to first principles by falling back upon the planer was made and the Gleason gear planer was extensively introduced for large work, and Hugo Belgrave, of Philadelphia, produced on the same general principle small gears of great accuracy. But the natural desire to crowd the planer with the milling machine was the author of the scheme to do

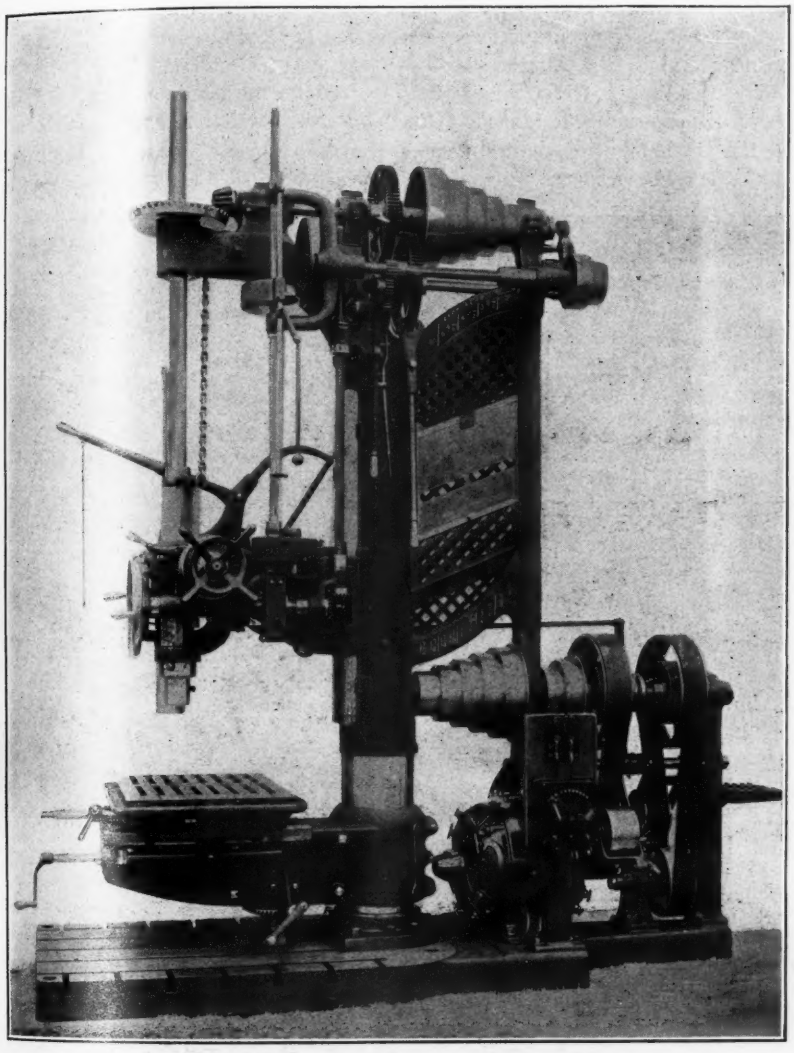


ELECTRICALLY OPERATED RADIAL DRILL.

what had been pronounced impossible by mechanics—*viz.*, to make theoretically correct bevel gears with a rotary cutter.

Mr. Warren, of the Pratt & Whitney Company, made the first venture in this line and accomplished very satisfactory results. His cutter was in halves, consisting of discs formed to cut on the face and at the developing angle of the involute of fifteen or twenty degrees. These cutters, as they rotated, were oscillated as to their spindles so as to furnish to the cutters the rolling motion of gears in action. These fed along guides set to form a cone of the angle of the gears to be cut, shaved the teeth to the correct shape, which shape demands that all lines of the sides, top and bottom of the teeth shall culminate, if projected, at the apex of the pitch cone. The first of these machines was made for the duplication of

fixed sizes and each gear required a machine built for its special angles. But machines more universal in character were designed, based on this principle, in which the slide angles were adjustable to meet the requirements of general work. Then Mr. C. D. Rice, of Hartford, produced another machine which cut theoretically correct bevel gears with a rotary cutter. The cutter was thin enough to enter the blanked out spaces between the teeth and rocked in and out exactly as the tooth of an engaging gear would do, the cutter being of sufficient diameter to cover the length of tooth or face of the gear without cutting too deeply into the body of the gear. With this method a very smooth and exact shape results and the concavity at the bottom of the space between is too slight to be objectionable. Another very successful form of the gear cutter, in which the planer principle holds its own, is the Fellows gear shaper, manufactured in Springfield, Vt. In this machine the cutting tool is practically a gear of any desired pitch and proper developing diameter for a full series of involute gears, and it is used as a rotating planer tool whose peripheral speed is timed with that of the work by means of change gears.



ELECTRICALLY OPERATED RADIAL DRILL MADE BY GOULD & EBERHARDT, NEW YORK.

Dinner to John Fritz.

The four engineering societies of the United States have decided to cooperate in the establishment of a medal to bear the name of John Fritz and to be awarded annually for distinguished accomplishments in the iron and steel industries. The societies cooperating in the establishment of the medal are the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. The medal fund was secured by small subscriptions, in order to make it representative, and the subscribers included, besides Americans, distinguished engineers and men engaged in the iron and steel industry in several of the leading countries of Europe. The fund raised amounts to something like $6,000.

On the occasion of the eightieth birthday of Mr. Fritz, a reception and dinner were given to him at the Waldorf-Astoria, New York city, this occurring Friday evening, October 31, and was a very brilliant occasion.

Mr. John Thomson presented the first Fritz medal to John Fritz, this being the unanimous decision of the committee, and also an album commemorative of the occasion and its meaning. Mr. Thomson's remarks were eloquent of the many accomplishments in industrial circles of Mr. Fritz, who responded in graceful words of thanks and appreciation.

Letters and telegrams were read by the chairman of the dinner committee, Mr. T. C. Martin, from Hon. Abram S. Hewitt, Andrew Carnegie, Charles M. Schwab, Irving M. Scott and others.

Mr. Calvin W. Rice, with other gentleman from engineering and electrical circles, managed the affair which was one of the most successful ever given in the United States, and gave proper honor to an inventor who has done probably as much as any living man to advance the iron and steel industry of the world.

Toasts were responded to by General Eugene Griffin and Professor Elihu Thomson, and among those in attendance from out of town were: F. C. Phillips and F. G. Tallman, of Cleveland, Ohio; Colonel E. D. Meier, St. Louis, Mo.; Charles H. Cramp, Philadelphia; Colonel N. H. Heft, Bridgeport; Dr. S. S. Wheeler and F. V. Henshaw, Ampere, N. J.; Professor Elihu Thomson, Lynn, Mass.; Dr. Henry S. Pritchett, Boston.

Among the New York diners were Theodore Beran, Robert C. McKinney, Gano S. Dunn, S. L. F. Deyo, General Eugene Griffin, F. B. Herzog, Charles W. Hunt, Walter C. Kerr, J. W. Lieb, Jr., Ray D. Lillibridge, T. C. Martin, Chas. A. Moore, E. H. Mullin, E. A. Leslie, H. F. De Puy, Charles A. Terry, Charles W. Price, Calvin W. Rice, Jessie M. Smith, Frederick A. Scheffler, W. A. Stadelman, John Thomson, W. J. Wilgus, B. J. Arnold, E. H. Wells, Arthur Warren, Dr. George F. Sever, H. H. Westinghouse and Captain E. L. Zalinski.

A High-Speed Locomotive.

A Description of the High-Speed Locomotive Equipped with Motors Built for 10,000 Volts.

By Enrico Bignami.

WE ARE in a position to understand the importance of the electric traction tests at high speeds on the Marienfelden-Zossen military line, described in Nos. 10, 11 and 12, of March last, and referred to again in the number of June 7 past. We think that our readers will be pleased to have a description of the high-speed locomotive equipped with motors, built for 10,000 volts, which has been prepared for these new tests by the house of Siemens & Halske, of Berlin.

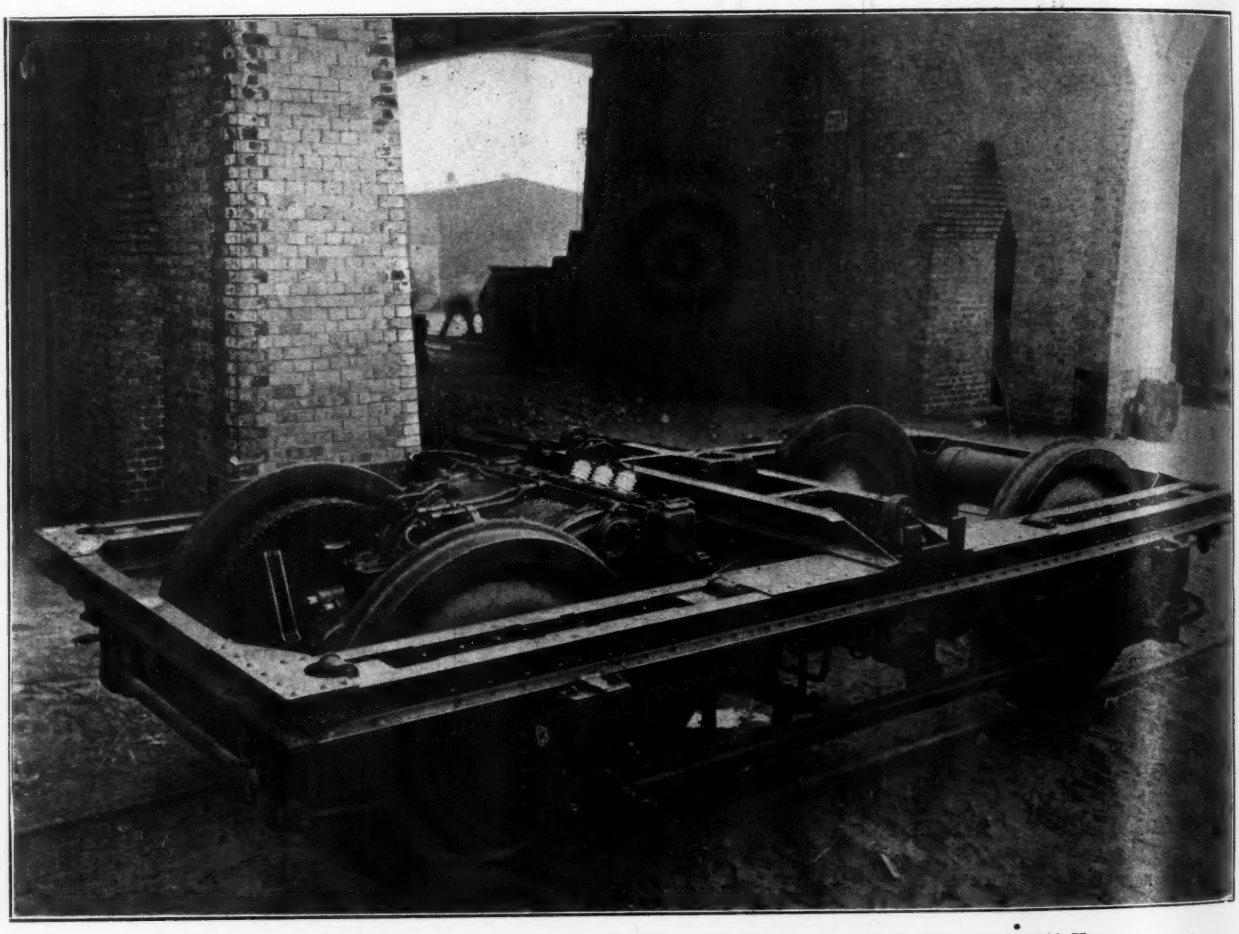


FIG. 1.—THE TRUCK CONSTRUCTED FOR HIGH-SPEED LOCOMOTIVE, EQUIPPED WITH MOTORS FOR 10,000 VOLTS.

Our readers will recall that in the tests of last fall the motor car constructed by the above house responded almost exactly to the calculations previously made.

During these tests the motor car easily reached at different times a speed of more than 155 kilometres an hour (at one time even 160.2 kilometres an hour). The car withstood at 100 cycles a pressure of 15,000 volts unloaded, and 13,000 volts loaded without any effort whatever, and showing no defects of insulation. The car constructed by the Allgemeine Electricitäts Gesellschaft behaved as well. This, on the occasion of tests made at the same time, as is recalled, attained a speed of 133 kilometres an hour.

Unfortunately, the defects of track construction necessitated repairs just at the time of high-speed tests. For speeds of 150 kilometres the rails were in general too weak and the substructure not solid enough, although the road stood the strain in some places where the bed was more solidly constructed.

On account of these troubles the state administration of railways put at the disposition of the committee conducting these tests heavier rails and the material necessary for laying them, and these new tests were actually made on a road having a more substantial construction.

In spite of the fact that the electrical equipment of the motor car justified the work which has been done, they have nevertheless attempted to improve other conditions consisting in the reduction of the weight of the car. This reduction will result in a saving of power, and especially will diminish the wear and tear on the substructure, reducing considerably the cost of maintenance. It will also further diminish the current flowing in the line, and when running at full speed, and particularly when starting at the terminal points, will effect a considerable saving of power to be transmitted.

As early as July, 1900, during the elaboration of the first project, the author conceived the idea of constructing

motors for high-speed traction which would receive, without the interposition of transformers, a tension of 10,000 volts. This was adopted, and the new vehicle, a locomotive, having four axles and two motors, was constructed. As it was desired to submit these motors to practical tests for traction, they could not be supported directly on the axle, but must be attached to this through gears. Guided by these considerations and others, a gear train, having a ratio of one to two, has been adopted for speeds of 100 kilometres an hour. (A transmission of one to four could have been adopted, corresponding to a speed of fifty kilometres an hour, or the motor could have been attached to the axles, through cranks, for 200 kilometres an hour.) It was natural that the vehicle constructed should be a locomotive. A motor car, in fact, would have necessitated a greater cost without presenting any appreciable advantages for these studies over the motor car already existing. We will now proceed to explain the construction of this locomotive, as described by the engineer, W. Reichel.

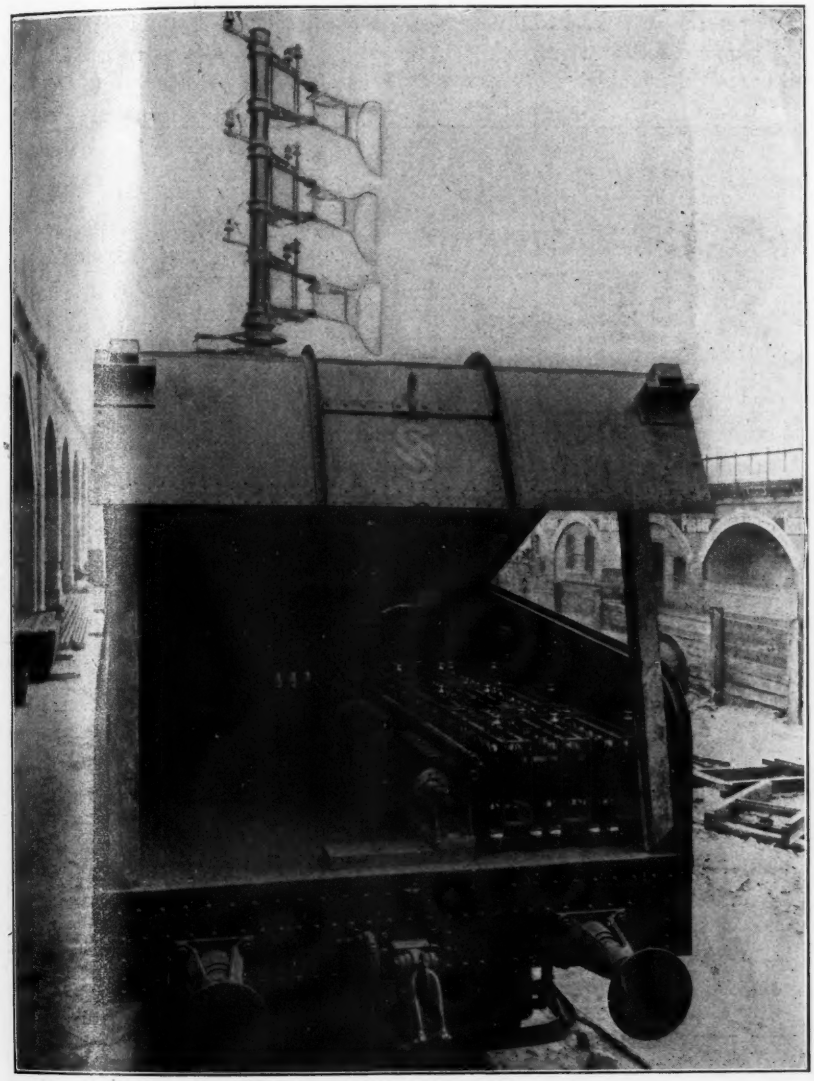


FIG. 2.—THE EXTERIOR COMPARTMENT, SHOWING SHEET-IRON COVER IN RAISED POSITION.

MECHANICAL PARTS.

The locomotive has four axles. It is constructed entirely of iron. The body rests by means of two centre bolts on two trucks, each of which has two axles. These are similar to those of the motor car and are constructed for a standard gauge. The wheels have a diameter of 1,250 millimetres. The wheel base is three and one-quarter metres. The journal boxes are similar to those of the high-speed motor car.

TRUCKS.

These were constructed for two motors each (Fig. 1). The frame of iron beams is reenforced by cross-beams and stays. The side-beam is formed of two channels, separated sufficiently from each other to admit the plate springs being placed between the boxes and the frame. The frame is thus suspended but once, while the step for the centre bolt, on which rests the body, is suspended from the frame by means of plate springs placed between the two cross-bars at the centre. At the two extremities of these cross-bars are placed wheels which prevent lateral oscillations of the body. The distance between the centre bolts is sixteen and one-quarter metres.

BRAKES.

These are of the Westinghouse type. They are operated by compressed air at a pressure of four atmospheres. They were designed to brake ninety per cent of the total weight. There are eight shoes, and the arrangement is such that each truck can be treated as an independent vehicle. For this purpose each truck is furnished with a brake cylinder with a diameter of twelve inches and an auxiliary reservoir. The piston of the brake cylinder moves vertically, operating through the brake rod by means of the cross levers, of which there is one for each axle. The hand-brake is attached to the same brake rod, but it works only on half of the shoes.

BODY.

This is 12.5 metres long by 2.8 metres wide, and consists of three compartments. The two low exterior compartments, having a length of 4.25 metres and a height of from one to two metres, are rounded off at the ends and provided with two removable covers. The central compartment, having a length of four metres, a height of 2.3 metres and a breadth of 2.8 metres, is placed symmetrically about the centre and forms the engineer's cab. This contains all the apparatus for operation, while the rheostats for starting and the controllers are placed in the lower compartment of the body. The side beams for the body are formed of channel beams 300 by 75 by 10 millimetres. They are reenforced by cross-bars and stays. To two side beams at the extremities are fixed buffers and couplers, conforming to the specifications for the state railways.

The floor of the body is wood, covered with thin plates. The walls are strong plates, reenforced by stays and resting on the exterior of the side beams, and are so arranged that the interior, enclosing as little construction as possible, is accessible from all sides. The exterior compartments are provided with sheet-iron covers, which can be raised, swinging on hinges (Fig. 2). The middle compartment, forming the engineer's cabin, is closed on both sides and the ends by win-

dows, permitting a free view in all directions (Fig. 3). Access is had through a door on each side. In the middle of each of the two walls of the front of the cabin is the wiring duct, 0.9 by 1.1 metres, for enclosing the principal switches and fuses and the cables conducting current to the motors. The weight of the locomotive is 24,000 kilogrammes, in round numbers, to which must be added that of the electrical equipment. This is 16,000 kilogrammes, in round numbers, so that the total weight is approximately 40,000 kilogrammes.

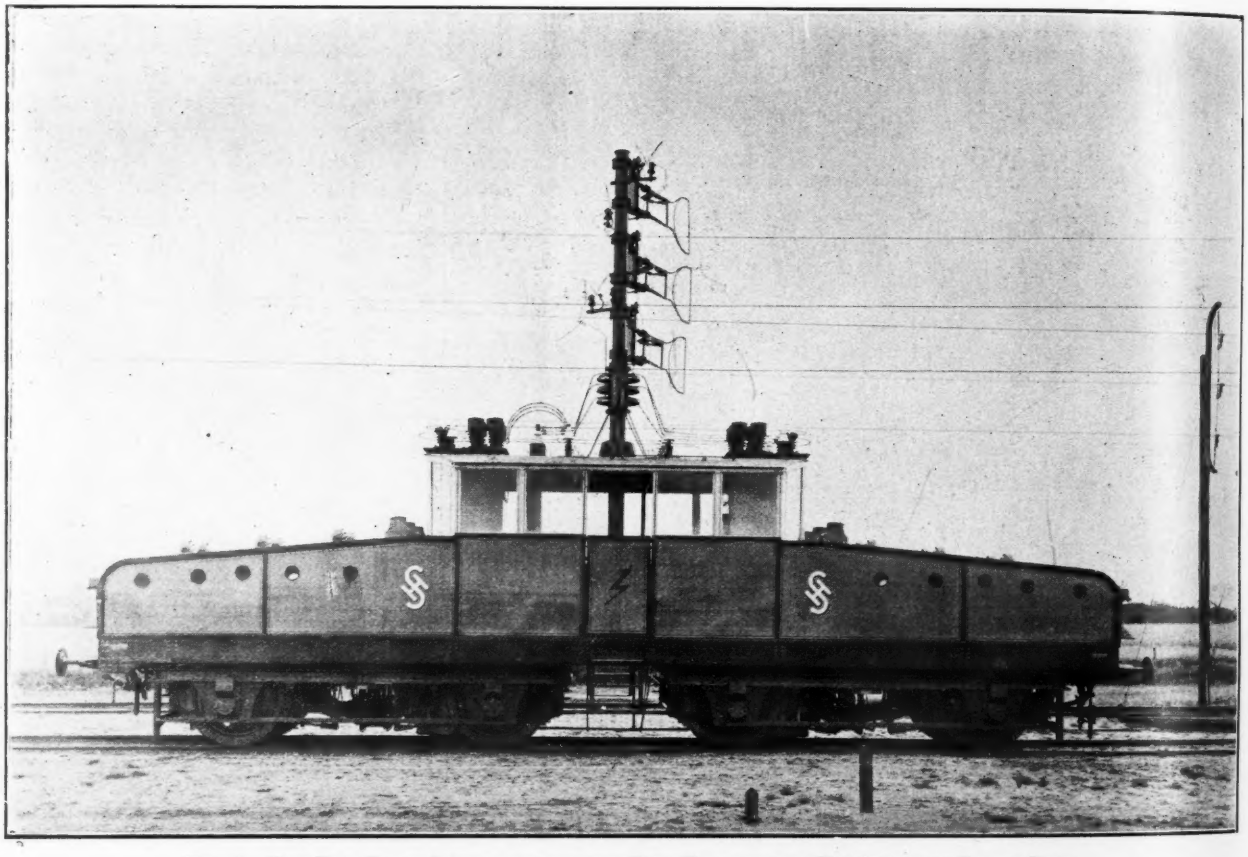


FIG. 3.—THE HIGH-SPEED LOCOMOTIVE FOR THE NEW TESTS ON THE MARIENFELDEN-ZOSSEN ROAD.

MOTORS.

In the construction of the motors, the principal question was that of inserting the coils, with the aim of using as economically as possible the space between the wheels, limited by the gauge. Special bearings of a single piece, containing sleeves, have been selected. These enter deeply into the interior of the motor, using the space already occupied laterally by the windings. The two sleeves are of the same length, and support equal pressures, in order to avoid inequality in wearing. To this end, the armature is furnished with a pinion at each extremity, in this way avoiding unequal pressures, which would result if but one pinion were used. Perfect symmetry is thus secured. The arrangement of the gear train on each side of the motor was further influenced, not only by the great pressure on the teeth, but also by the extremely high speed, which has not been used up to this time. On account of this speed, it is not sufficient to run the gears in a bath of oil or grease, but it is necessary to feed oil, under a pressure of several centimetres of mercury, between the teeth, and the locomotive has been provided with an air pump, producing a pressure of five centimetres of mercury, which draws oil from a reservoir, through a pipe, to the engineer's valve. Turning this to the right or to the left causes a flow of oil to the front or rear of the locomotive. The oil passes from the valve in two pipes, flowing into the pipes placed above and below the gears. The oil in this manner enters between the toothed wheels, and falls finally to the bottom of the protecting case, whence it is raised by a pump (driven either by hand or by a motor), and flows into the oil reservoir.

The carcass of the motor has approximately the same dimensions as those of the motors of the motor car. It is cast in two pieces, of steel, and turned only on the interior, to the end that the iron laminations, when in place, will be in contact over the whole surface, and form a good conductor of heat. The bearings, formed of a single piece, are furnished with sleeves of bronze filled with white metal in order to reduce wear to a minimum. They are 300 millimetres long and 100 millimetres in diameter. In this way it is possible to reduce the air-gap to 1.5 or 2 millimetres, and to obtain excellent magnetic conditions in the motor. To the carcass, having an interior diameter of 990 millimetres, is attached the iron core, in which are inserted primary windings. The rotor is fixed on the axle by means of a sleeve, in order to provide for supporting the motor directly on the axle, should it become necessary. The useful iron of the rotor, containing the secondary windings, is assembled by pressure under the end-plates, and held in place by a large number of bolts. Another special sleeve, of cast steel, supported on the first, carries the two collector rings, on which rest carbon brushes. An inspection of the interior of the motor can be made through three openings in the carcass, closed by covers. The motor is lubricated with oil by means of wicks.

To obtain a better casing, the end-plates are bolted to the carcass (Fig. 4),

while the eyelets which transmit by means of springs the weight and the turning effort of the motor to the truck are cast in one piece with the carcass.

Concerning the windings, the present article will not attempt to treat of the details, but will be content to give the principal data. It was quite impossible to place the primary windings on the rotor, as was done in the high-speed motor car. This position is admissible for bar windings, but was prohibited in this case by the high tension. The magnetic circuits of the rotor and stator is formed of very thin laminæ. Those of the motor are in one piece, while those of the stator are composed of different segments.

A calculation of the windings gave the primary seventy-two open slots, with sixty-seven wires per slot. The coils (form-wound) of the winding are connected in star and placed in mica tubes. In order to fully use the space, and to secure a very effective insulation, the different coils are placed alternately in long and short tubes so that the longer tubes extend beyond the shorter (Fig. 5).

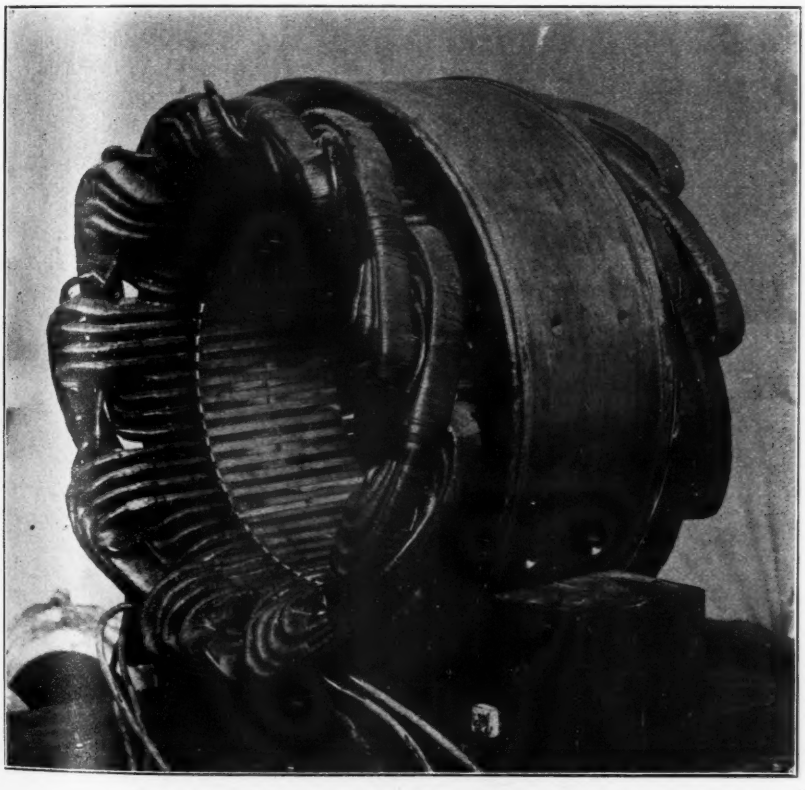


FIG. 5.—SHOWING THE WINDING OF THE MOTOR.

In this way the possibility of short-circuits from one phase to another is appreciably diminished. This method of insulating the high-tension coils was determined after many tests. During these tests the coils resisted a pressure of 22,000 volts without suffering any injury or showing any signs of breakdown.

The winding of the rotor is placed in ninety slots, semi-closed, and is formed of copper bars placed in the core. They are connected in series with four bars per slot. The coils of the windings, which are zigzag, are connected in star. Two of the free ends go to the collector rings, while the third is fixed to the core of the rotor. The pressure in these rotor windings is 700 volts at starting. The use of bars for this winding facilitates the application of bronze rings to hold the winding against centrifugal force, and permits a very good ventilation. Air which enters about the axle is thrown toward the exterior with force by means of strong wings cast to the core of the rotor so that it passes across the openings there provided at a high velocity.

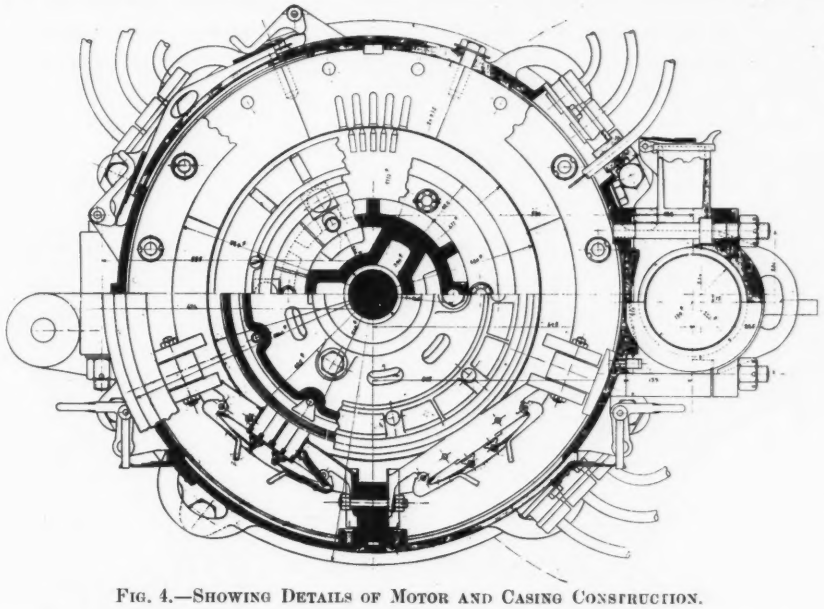


FIG. 4.—SHOWING DETAILS OF MOTOR AND CASING CONSTRUCTION.

The velocity of the air is six metres per second. The quantity moved is 120 litres per second. To prevent the passage of a spark between the bobbins and the carcass, those parts placed close to the primary windings are covered by a thick coating of mica, and these windings have been extended as far as possible from the carcass.

The introduction of three high-tension conductors into the interior of the motor has been carried out with great care. They enter through three sleeves of rubber, protected themselves by larger ones of ebonite. The insulation of the conductors was made to withstand a tension of 15,000 volts. These porcelain insulators, which in turn are fastened by collars on three iron tubes, are enclosed in mica, so that this place also is sufficiently insulated for a tension of 10,000 volts (Fig. 6). The weight of the motor is 4,090 kilogrammes.

STARTING AND REGULATING THE MOTORS, COLLECTING THE CURRENT AND COMPRESSING AIR.

CONNECTIONS.

The diagram of connections (Fig. 7) shows the course of the current and the apparatus used. These, with the ex-

ception of the rheostats, are constructed in the same way as those of the high-speed motor car (see ELECTRICAL REVIEW, Nos. 10, 11 and 12, March, 1902). The speed of starting is regulated by the resistance interposed in the secondary circuit of the motor. The controller is

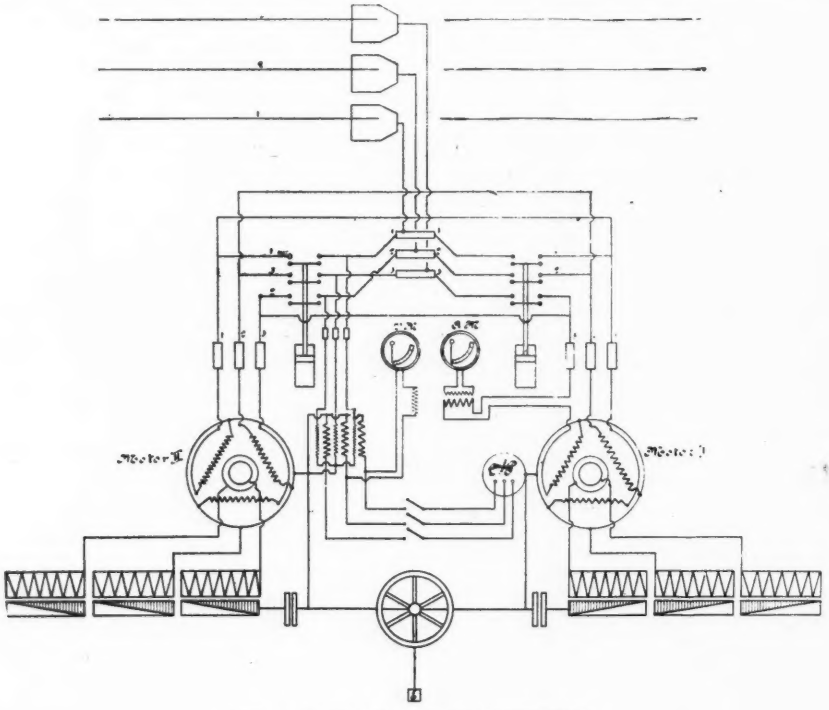


FIG. 7.—THE DIAGRAM OF CONNECTIONS.

shown in the diagram as being operated by hand. It is insulated, the third phase of the motor being connected to the earth. The two other secondary phases are connected to two collector rings on the rotor. The current reaches the main switch through fuses in the primary circuit of the motor.

The switch is moved by a piston operated by compressed air, and this serves at the same time as a reversing switch by changing over the phases. Wires to the small conductor branch off through fuses from mains which are carried to rings on the collecting trolley. The small transformer furnishes, through a switch shown in the diagram, current to a low-tension motor which drives the air pump. The ammeter and voltmeter are connected in the upper circuit.

Starting the locomotive and regulating the speed are accomplished in the manner indicated by placing resistances in the secondary circuit of the motor and cutting this out of circuit. Twenty-four coils of resistance are provided. The first of these serves to prevent sparkings on opening the circuit, and avoid, as well, too heavy a current at starting. These resistances are in no way different from those in general use. They are spirals of German silver, connected in parallel and fixed by means of insulators to iron beams. The controller is of the A-B-C type, and is similar to those of the high-speed motor car, with the difference that one of the three phases is not insulated from the ground. (This was not the case for the motor car.) The drums of the controller are turned by means of a vertical handle fixed on the engineer's table.

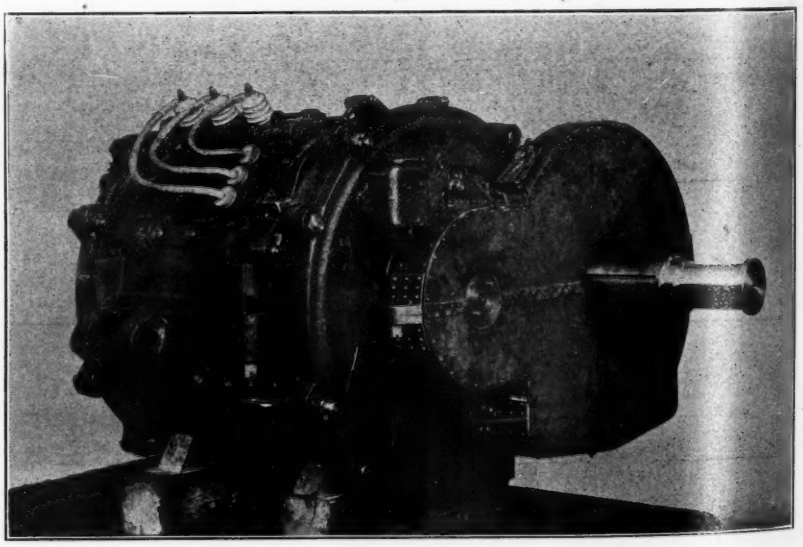


FIG. 6.—HIGH-SPEED, 10,000-VOLT MOTOR, SHOWING HIGH-TENSION TERMINALS.

Manipulation is extremely easy and simple. Throwing the primary winding in circuit, and at the same time changing the direction of motion forward or backward, is accomplished by high-tension switches operated by compressed air. They are placed in wiring ducts on the front wall of the engineer's cabin.

From his table the engineer can operate them by means of a valve. The motors are protected by high-tension fuses enclosed in tubes, which are also placed in the ducts just beside the main switch.

A window allows the operation of the controller and the main switches to be watched. The current-collecting apparatus is placed in the centre of the car. It is formed of a single Mannesmann tube, fixed to the floor in a step bearing, and supported at the roof by a collar. At the top it bears the three contact bows and springs. The conductors on the roof of the locomotive are bare copper, fastened to porcelain or ebonite insulators. The air necessary to operate this apparatus is compressed by means of a small pump operated by a 110-volt motor, the current for which is furnished by a small transformer which reduces the tension from 10,000 volts to that indicated.

ENGINEER'S TABLE.

This is placed in the centre of the locomotive, a little to one side of the longitudinal axis (Fig. 8). The axis of the table is parallel to that of the locomotive, so that the engineer standing before the table must turn his face to the right or left in order to watch the track. On the engineer's table is found the handle for operating the controller. To the left of this table is the switch for the air pump; to the right, the valve for the main switches, which also reverses the motors. To the right is found the valve for operating the Westinghouse brakes. Before the engineer is the pole carrying the bows for collecting the current. This can be

approached to, or removed from, the wire by means of a simple handle. The hand-brake can be operated by the horizontal handle placed before this pole. The measuring apparatus for the pressure of the air, the voltage and current are fixed on the wall of the wiring duct at such a height that the engineer can easily see them. A place has been reserved for a speed indicator which will be installed in place later when the speeds exceed 100 kilometres an hour. Below this apparatus is the oil reservoir and hand pump for lubricating the gears.

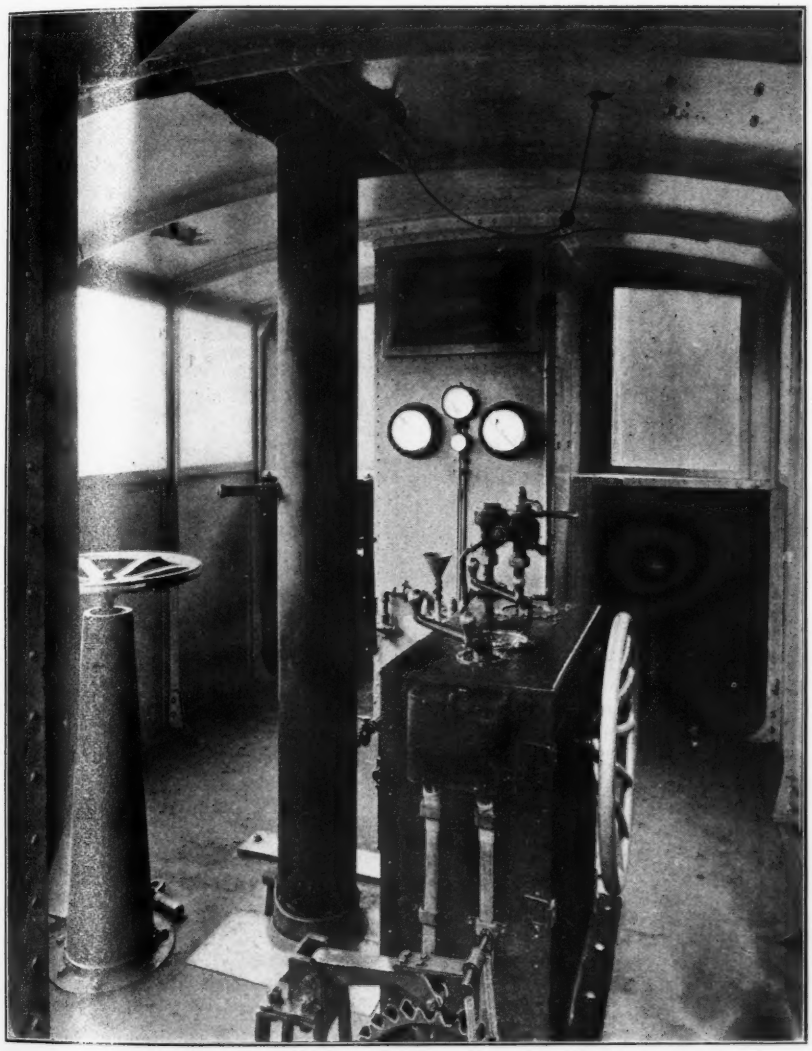


FIG. 8.—THE ENGINEER'S TABLE AND AUXILIARY CONTROLLING APPARATUS.

TRACTION TESTS.

The locomotive was recently tested at speeds from 55 to 100 kilometres an hour, and with frequencies and voltages increasing from 55 cycles and 6,000 volts to 95 cycles and 11,000 volts. These tests were made in the presence of a large number of officials from the administration of the military railroads and the Studiengesellschaft. A first and second-class passenger car, having four axles and a weight of 31,000 tons, was coupled to the locomotive. The maximum speed attained was 105 kilometres an hour. At this speed the gear-wheels turned without appreciable noise, and the motors operating under full voltage without criticism. The motion of the locomotive and its trailer was very smooth.

The consumption of energy was 260 kilowatts. This corresponded to a power of 280 horse-power, measured at the axle, agreeing exactly to the experiments made at speeds of 100 kilometres. To determine the tractive effort of these motors starting tests have been repeated at different times, as also during the last traction tests. During these tests the locomotive could start with the Siemens & Halske high-speed motor car attached, giving a total weight of 132 tons in round numbers. These tests have justified the construction of the motors and have answered an objection made to the application of the transmission of electrical energy for long-distance lines. In securing for these lines the speed already attained, of 160 kilometres an hour at thirty cycles and 8,000 volts, 100 passengers can be carried in a motor car equipped by means of these motors which we have described, and trailing a second car, having six axles, of forty-two tons, which will give per passenger a gross weight of about 1,250 kilogrammes, while for a corresponding performance by steam the gross weight necessary would be about 1,900 kilogrammes. This will show an appreciable difference existing between the two systems in the consumption of energy, depreciation of the road, etc.

These tests, which are to be extended to a still higher speed, will show further the superiority of electric traction over that of steam, and will make a new step in advance in the application of three-phase currents to traction.

Annual Inspection Tour of Electrical Students.

The annual inspection tour of the department of electrical engineers, senior class, University of Illinois, was held from October 20 to 26. The different points visited included: The Arnold Electric Power Station Company, the Board of Trade plant, the Anderson plant, the Chicago Public Library plant, the Chicago Edison Company. The electric installations in Marshall-Field & Company's new store, the Western Electric Company, the electrically operated bridges on the Drainage Canal, stage lighting of the Illinois Theatre, the Chicago Telephone Company, Postal Telegraph Cable Company, underground tunnel system of the Illinois Telephone and Telegraph Company, Metropolitan West Side Elevated Railway Company, the Aurora, Elgin & Chicago Railroad, the South Side Rapid Transit Company and the Stock Yards were also visited.

Accelerated Service on the Liverpool Overhead Railway.

The Liverpool Overhead Railway, having felt the keen competition of the electric trams, recently decided to inaugurate an accelerated service. This was tested a short time ago. A train was run under ordinary working conditions, making at all sixteen stations the regulation stop of eleven seconds, and the run was done in just over schedule time. The length of the line is six and one-half miles, and the new service is being carried on by trains which perform the journey in twenty and one-half minutes, or at the rate of nineteen miles an hour. The old five-minute service required fourteen trains, whereas by the acceleration a five-minute service can be carried on by ten trains. Each of the trains is fitted with four 100-horse-power railway motors.

THE DESIGNING OF TELEPHONE APPARATUS—VIII.

BY W. A. TAYLOR.

In years past where a number of series telephones were used on one line the series generators were wound with an immense number of turns of fine wire in order to obtain a very high voltage for ringing through great resistance. Nearly all series party lines have now been changed to bridging lines, and consequently the series generator is used almost entirely for exchange purposes.

The bridging generator must be wound so that the current will divide into a number of parts, each part passing through a bell. In bridging systems all bells are connected parallel or in multiple in the same way as parallel electric lighting. A generator which will give a large quantity is therefore needed in order that the current may divide between a number of bells, giving each enough to ring with. Enough space must therefore be made on the armature core so that a fairly coarse wire may be wound upon it giving sufficient turns. Four magnets are usually used with a bridging generator, though some are made using five and even six magnets. One manufacturer advertises an eighteen-magnet generator. In the writer's opinion a four-bar generator may be made sufficiently strong to ring all the telephones that can be successfully used on a line. It is generally supposed that a five-bar generator will give better results than a four-bar, and it will if properly designed. The usual practice is to increase the dimensions of the machine only in length, making no increase in the winding space. The same number of turns of the same sized wire as is used in the four-bar generator is then wound upon the armature core. The magnetic field is increased twenty-five per cent, that will increase the open-circuit voltage in like amount, but the resistance of the winding has increased twenty-five per cent because each turn is twenty-five per cent longer. On account of the higher resistance in the armature the increase in voltage is neutralized when the generator has a load. Now, if the armature is wound to the same resistance there would be twenty-five per cent less turns, and the voltage decrease due to the reduced turns would just balance the increase in the magnetism due to the extra magnet. What is necessary is to increase the diameter as well as the length of the armature, then a coarser wire may be used and more turns obtained with a less resistance.

The series generator is nearly always made with three magnets and of the same dimensions as the bridging generator, except that it is made shorter. It is usually provided with a shunt or automatic short-circuiting device. This device is generally operated by a cam motion of some kind which automatically removes the short-circuit when the crank is turned.

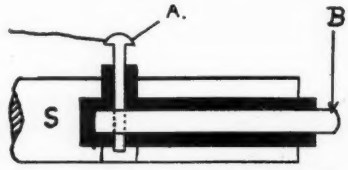


FIG 15.—THE INNER-WINDING CONNECTION.

Other generators have a centrifugal shunt. In any case the shunt must be so constructed that it will always make perfect contact, holding the machine normally short-circuited. On the other hand, the shunt must always act instantly when the generator is started. The shunt has been a point of weakness with generators. It seems that there was always something to get out of order. With

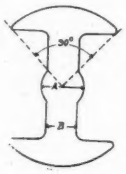


FIG. 16.—CROSS-SECTION OF ARMATURE.

the better class of generators there is little or no trouble from this source at present.

The bridging generators have a cut-in switch which automatically connects the generator to the line as soon as the crank is turned. This is also generally called a shunt, but wrongly, as there is no shunting action.

In preparing the armature core for winding, the ends should be covered with fibre pieces of the same shape and size as the laminations of the armature. A fibre tube about three-eighths inch long should

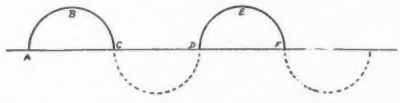


FIG. 17.—APPROXIMATION OF CURRENT CURVE.

be slipped over the ends of the shaft against the end of the core to keep the wire away from the shaft. The rest of the armature core should be covered with cotton cloth and well shellaced. In making up the armature core it is usual to place one small lamination in the middle. This piece is about one-sixteenth of an inch smaller than the rest. After the armature is wound, a binding string is tied around the groove left by the small lamination to keep the wire from flying out against the pole-pieces when the armature is in motion. The armature winding should never be shellaced to hold it in place, for in case it is ever necessary to rewind it, it will be impossible to remove the wire without cutting it off.

The inner end of the winding is usually connected to the core of the armature. The outer end is fastened to a pin which connects with another pin that passes out through the end of the shaft, as is shown in Fig. 15. A is the pin upon which the wire fastens; B is the pin passing out through the end of the shaft S. Pins A and B are both insulated by bushings of hard rubber. A passes through a hole in B. A is slightly tapered to make a driving fit in most makes of generators. It is best if this pin is screwed into B, as then there is no danger of an open circuit occurring. A great deal of care must be exercised in insulating these pins, as this is one of the weak points of a generator and the hardest to repair.

The size of wire used on a generator depends, of course, upon the size of the armature core. Fig. 16 represents the cross-section of an armature of a generator which is in very successful use. The diameter is one and three-quarter inches. The arcs of the cheeks are ninety degrees; thickness at A, one-half inch; thickness at B, three-eighths inch; length of core, three inches; diameter of shaft, five-sixteenths inch. This was wound with 1,900 turns of No. 32 single silk-covered magnet wire. Half of the turns were on each side of the shaft. The resistance was 225 ohms. This was the armature for a four-bar bridging generator. The armature of the three-bar generator was one inch shorter and had the same number of turns of the same sized wire. The air-gaps of these two generators were one-fiftieth of an inch each.

A special form of generator is used where the bells on a line are to be rung selectively. These are known as pulsating current generators. In these generators the positive or negative impulse is cut out altogether so that the current curve approximates something like Fig. 17. The heavy part of the curve represents the current, starting at the point A, where the value is zero and rising to a maximum at the point B, then falling to zero again at the point C. This portion of the curve represents half of a revolution of the armature. From C to D the current is zero when it commences to rise again, describing the curve DEF. The broken line represents the course the curve would

have taken had the current been alternating. The arrangement necessary to obtain these results is shown in Fig. 18. A is a collector ring or commutator upon which the brush B presses. The half C is of metal and the other half D is an insulated segment. When the armature E revolves current is collected by the brush during only half of the revolution, while during the other half the current is cut out. Thus while the current passes in one direction through the armature current is taken off, but is cut out during the pressure in the opposite direction. Sometimes there are two of these collector rings oppositely placed so that from one brush a positive impulse is taken, while from the other a negative is taken. The other terminal of the machine is the pin in the end of the shaft in each case. A pulsating-current generator is frequently used in the bridging telephone for toll-line use, so that other bells can not be rung. In this case all calls go into a central point where the operator attends to the necessary calling. The bells on these telephones are all of the biased kind. The reason for this kind of service is the prevention of dead-heading messages over the lines. The central operator does all the calling and therefore checks all messages. This system also gives the signaling into the hands of a competent person, and there are not so many misunderstandings.

THE RINGER MOVEMENT.

In all telephones, with few exceptions, a polarized bell is used for signaling. The few exceptions are in telephones which are used on short lines. In these the ordinary vibrating bell is used, operated by means of a current from a battery. Fig. 19 shows the arrangement of the typical polarized bell such as has been commonly used throughout the United States. AA are the two coils of the windings; B is a permanent magnet which is fastened to the magnet yoke L. The pole N of this permanent magnet is bent over at right angles, as shown in Fig. 20, so as to bring it directly over the armature M. By fastening the permanent magnet in this way the armature M becomes magnetized so that both ends are of the same polarity. The lines of force from the magnet pass from the pole N to the armature M where they divide, half entering each of the magnet cores D and G; then they pass through the cores to the magnet yoke L and then reenter the permanent magnet, completing the magnetic circuit. There are normally two S poles at G and D and two N poles at the ends of the armature M. Suppose a current passes through the winding which will make G an N pole and D an S pole, the armature will then be repelled from G, being like poles, and it will be attracted to the pole D. Now, if the current is reversed so that D is the N pole and G the S pole, the armature will be attracted by G and repelled by D. The vibrating of the armature thus throws the clapper H back and forth, striking the gong at each stroke. It will be seen that in order to produce this vibration the current must be reversed

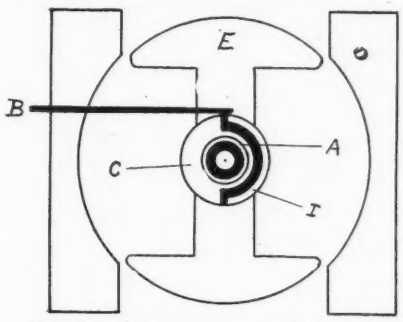
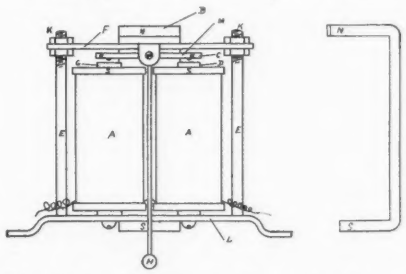


FIG. 18.—ARRANGEMENT OF GENERATOR COMMUTATOR.

at each stroke; for this reason an alternating current is used. The armature M is held by a cross-piece F, and this piece is clamped in position by the nuts KK. The distance of the armature from the poles is regulated by these nuts, KK. The two posts EE and cross-piece F are usually made from brass; they should never be made from iron, as they would shunt the permanent magnetic field from the magnetic cores G and D.

When a piece of iron is attracted to an electromagnet it will be observed that it



FIGS. 19 AND 20.—TYPICAL POLARIZED BELL.

sticks even after the current is turned off from the magnet. If, however, the piece of iron is removed and then placed against the unexcited magnet it can not be made to stick. Because of this sticking tendency on the part of an iron armature, it is customary to interpose some non-magnetic substance between the armature and the core of the ringer, otherwise the armature would stick to one or the other of the poles and will not vibrate. The usual method is to place a small brass or copper pin in the ends of the armature so that these pins strike the pole. The pin need not protrude any farther than to just prevent the armature from touching the poles. In order to get the most sensitive results the armature should be as close as possible without sacrificing the length of the stroke. If the length of stroke is too short the gongs will not receive a sufficiently hard blow.

It is especially necessary that all iron parts of the ringing movement shall be of the finest of annealed iron. If any residual magnetism remains in the movement the armature is apt to stick to the poles of the electromagnet. In order to economize in the cost of production builders have from time to time attempted to use cast iron for the yoke or base, but at best only indifferent service is given. The permanent magnet steel is of the same analysis as that used in the generator and receiver, and is treated in the same way for hardening and magnetizing.

The winding is of two kinds, the series and bridging. The former winding is used almost entirely in instruments for exchange work and on lines where there are no more than two telephones. The winding has a resistance usually of eighty ohms, though there are many wound to a resistance of 500 ohms. The eighty-ohm ringer is usually wound with No. 30 B. & S. single silk-covered magnet wire and has about 4,200 turns. The 500-ohm ringers are used by many of the Bell companies, the resistance being changed from eighty ohms at about the time these companies changed their clearing-out drops on the switchboards from the series kind to the bridging. These bridging drops were wound to 600 ohms, and on account of the high resistance it was hard to throw the drop because of the short-circuiting effect of an eighty-ohm ringer. Instead of reducing the resistance of the drop they went to the greater expense of increasing the resistance of all the bells. It would no doubt be a very good idea to have the series bell wound as high as 200 ohms, then there would be no possible doubt of throwing the clearing-out drop even with a very weak generator. In the series telephone the bell movement is cut out while parties are talking, and therefore there is no cutting down of the transmission except where a number of series telephones are placed on one line in series with each other.

The series telephone for party line work is being largely superseded by the bridging telephones. In the latter telephone the bells are all normally connected to the line, but instead of being in series with each other they are all in multiple or parallel with each other. In order to prevent the interfering with the transmission, the bridging bell is wound usually to 1,000 ohms resistance and with about 16,000 turns. Such a bell presents an immense amount of retardation to the voice current. Some of these bridging bells are wound much higher in resistance, 1,600 ohms being common and 2,000 ohms not unusual. The higher-wound bells are used where a great number of telephones are to be used on a long line.

THE CONSTRUCTION OF TELEPHONE EXCHANGES—XLVI.

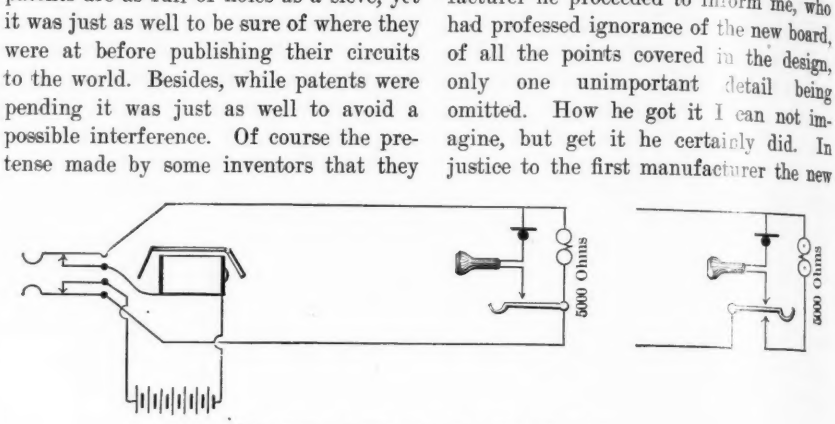
BY A. E. DOBBS.

CENTRAL BATTERY REMARKS.

One of the greatest troubles found with central battery systems in many parts of the country has been the lack of men who knew how to take care of them. It is true some enthusiastic promoters of these systems have been loud in their claims that central battery systems did not need any care except at the central office and that their instruments never needed inspection, but this, like many other claims, has been found to be incorrect, for the telephone instrument has not yet been constructed that did not need more or less inspection, and the best central battery instruments, with the exception of the batteries, need as much care as the best local battery instruments, and the exchange manager who certifies that none of his instruments has been inspected for a year convicts himself of negligence or incompetence.

Any man capable of understanding a return call-bell system can master a central battery circuit, but still it requires a higher degree of intelligence on the part of the inspectors and troublemen than the old-style magneto system. Of course it must not be forgotten that the older system has been training men for more than twenty years in the art of taking care of that particular style of instrument, and the work had been largely memorized and reduced to mere routine labor while centralized systems presented an entirely new circuit, the outlines of which are often jealously guarded, so much so that many exchanges have been installed without even a blue-print or sketch to show the circuit. In many cases, even when a blue-print was shown at the installation of the board, changes in the wiring of the circuits were made by the man in charge which did not appear in the plans, and even if the local inspector was smart enough to borrow or steal a copy he was liable to become befuddled in trying to trace his circuits. To this policy of mystery and concealment, no doubt some of the failures attending the installation of centralized systems were largely due, as some of them seem to have died of neglect on the part of the local management.

There was a certain amount of justification for this policy, perhaps, for up to two years ago every exchange installed was, to a certain extent, an experiment in which some new arrangement of circuits or appliances was tried out; then there was the patent situation which kept many manufacturers on the anxious seat, for several inventors were kept busy covering every device and form of circuit they could think of, and, though there is a strong suspicion that central battery patents are as full of holes as a sieve, yet it was just as well to be sure of where they were at before publishing their circuits to the world. Besides, while patents were pending it was just as well to avoid a possible interference. Of course the pretense made by some inventors that they were afraid their rivals in business would learn their circuits was bosh, for every manufacturer who is at all wide awake manages, one way or another, to find out what the others are doing.



FIGS. 197 AND 198.—AN OLD-TIME CIRCUIT.

I remember in one instance of meeting a Chicago manufacturer who was very secretive, and fondly imagined that no one knew his circuit but himself. I could hardly refrain from laughing in his face, for at least three rival factory superintendents had every essential detail of his circuit committed to memory and could sketch it off at a minute's notice.

In another instance I found that a

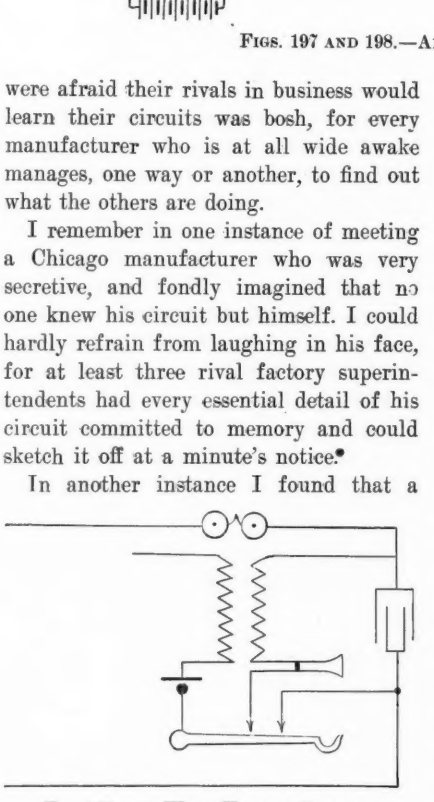


FIG. 199.—A WELL-KNOWN CIRCUIT.

rather dull and boyish-looking individual had engaged to work in a factory as a bench-helper at $1.25 a day, but he was not as dull as he looked, for he was as good a switchboard man as there was in the city, to whom circuits were an open book, a fact the factory did not discover till after he had left, and, it is reasonable to suppose, that the $1.25 per diem did not represent his entire earnings.

Upon another occasion a manufacturer showed me a blue-print of his new switchboard in strictest confidence, and assured me that no one but himself and a foreman, whom he could trust, knew anything about it. The board had then been shipped and set up as a trial installation and strict orders given to exclude visitors. Judge of my surprise a few days later when in conversation with another manufacturer he proceeded to inform me, who had professed ignorance of the new board, of all the points covered in the design, only one unimportant detail being omitted. How he got it I can not imagine, but get it he certainly did. In justice to the first manufacturer the new board proved a success, and when a few weeks later the patent claims were allowed, the ban of secrecy was removed.

Moreover, as long as men leave one factory and go to work in another it is reasonable to suppose that they will cultivate the good will of their new employers by telling what they know of other circuits.

In these days almost every conceivable detail of central battery circuits having been worked out, an experienced man who is familiar with them can tell at a glance just what the system is if he can get a chance to open one of the instruments, see the back of the switchboard and relay rack. That being the case, would it not be better when a switchboard is installed to give the inspectors every possible advantage by letting them see what the circuit is like instead of letting them guess about it and perhaps guess wrong and possibly condemn the system through lack of knowledge? Besides losing possible criticism and suggestions for improving the system, an inspector's criticism of an exchange often goes much further than is often realized, especially when a visiting committee from another town comes around to look the exchange over, for if that committee is wise the members will make it a point to have a talk with the inspector and subscribers as well as the owners; for the former will be likely to give them more accurate information as to the actual working of the plant than the latter.

SIGNALING THE SUBSCRIBER.

With only one telephone on a line there are at present only about three methods

of signaling in use, and this is now so well understood that the purchaser of a central battery switchboard is no longer tied down to instruments of one manufacturer, as the central battery instruments of one manufacturer can be used with the switchboard and system of another if desired, as is done in Philadelphia and Toledo. In the first place, it is necessary that the line should be open at the subscriber's instrument until closed by the lifting of the receiver from the hook, as battery is present over the entire length of the line all of the time, ready for the subscriber to call in. In the magneto or self-contained system the generator at the station is open or shunted till the subscriber, by turning the handle automatically, puts it in circuit. In the central battery call, the ring is open through a condenser till closed by the operator, or by an alternating current which will pass through a condenser and ring the bells.

One of the oldest systems is shown in Fig. 197. In this case we have at the subscriber's instrument a transmitter, the circuit of which is open when not in use. The bell at the subscriber's station is wound to very high resistance, 5,000 ohms, which prevents battery enough from flowing to actuate the drop or relay, D. Let us suppose that with the battery in use the drop or relay will fall only when the line resistance does not exceed 900 ohms; then it is very evident that as long as the bell at the end of the line keeps the resistance up to 5,000 ohms or more the drop will not fall, but when the resistance falls to 100 ohms the drop or target will move. This system, however, takes so much battery that it is now generally discarded and a condenser inserted in the bell circuit; the hook may or may not cut out the bell as it rises, as shown by a comparison between Figs. 197 and 198. In either case when the hook rises there is a resistance not exceeding 100 ohms thrown across the line, and the armature of the drop or relay is drawn forward and remains in that position till the operator plugs in, when it falls back into position of its own weight and the battery springs in the jack being open battery is transferred to the cord circuit through the leads, *c c*, for furnishing battery to the subscriber as well as controlling the clearing-out signals. The subscriber's instrument may or may not be equipped with an induction coil as desired. In ringing the station the operator plugs into the jack, cutting off the battery there, and rings with a generator in the usual manner, as the office generator possesses sufficient voltage to overcome the 5,000 ohms resistance of the bells.

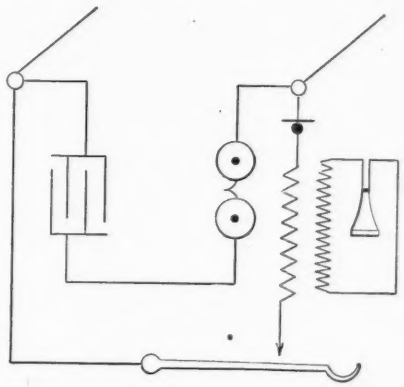


FIG. 200.—RECEIVER IN ONE CIRCUIT ONLY.

Fig. 199 indicates a circuit but slightly different from those already considered, except for the condenser, which keeps the line open to battery current while an alternating or intermittent current will ring the bell through. When the hook comes up, however, the line battery is short-circuited through the primary of the induction coil and the transmitter, the arrangement of the drop or target being the same as in the previous figures. The receiver, however, instead of being in series with the transmitter is in a local circuit by itself, connection being made by way of the secondary coil, S′, and the condenser, K, and the contact 3. As the bells are of rather high resistance the receiver current can not pass through them back to the line, and the circuit is strictly local. With the hook down, the transmitter circuit is open, as well as the entire line, except to alternating currents which are passed along by the condenser.

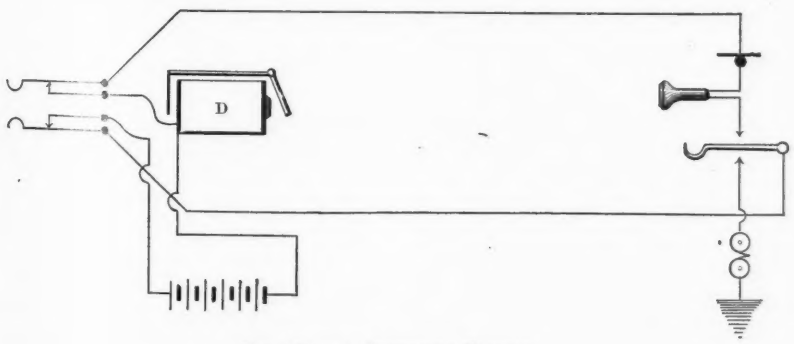


FIG. 201.—A GROUNDED RINGER.

Fig. 200 shows the wiring of a somewhat similar circuit, with the exception that the receiver is entirely separate from the rest of the line, there being no connection whatever, not even through the condenser.

In Fig. 199 the induction coils are said to be wound to a resistance of eighteen and twenty-six ohms, respectively, while that shown in Fig. 200 is wound to one ohm in the primary and seventy-five ohms in the secondary.

We now come to the third method, shown in Fig. 201. This plan leaves one side of the line open altogether until the receiver comes off the hook when it closes the battery circuit through the drop or target. The bells are connected to one side of the line to ground. To ring the subscriber, one side of the generator must be grounded and the ringing, as described in previous chapters, done through one side of the plug. There is not usually a condenser in the ringing circuit except in the case of party lines, or in places where a grounded line might be greatly troubled with parisitic currents.

Now a word as to the terms "drop," "target" and "relay" as used above:

The drop form of annunciator is the form used in all magneto systems, and when the shutter falls it stays down till it mechanically is restored to its place again. The target which is indicated in Figs. 197 and 201 resembles the drop, but, as used in central battery systems, the shutter does not fall; instead, it is raised as the armature is drawn forward and falls back into place again by gravity when the circuit is broken.

A relay is used to either work another relay or a local lamp circuit, and often takes the place of the target of which we will speak later.

The October number of the *Yale Scientific Monthly* has come to hand. This contains an interesting article on "The Practical Possibilities of a Scientific Education," by R. H. Crittenden, director of the Sheffield Scientific School. Mr. B. M. Couch contributes a brief account of the collection and restoration of fossil vertebrates discovered in southwestern Wyoming. "The Rise of the Beet Sugar Industry," by Mr. S. Marshall, is another interesting paper.

Electrical Notes from Europe.

(By Our Special Correspondent.)

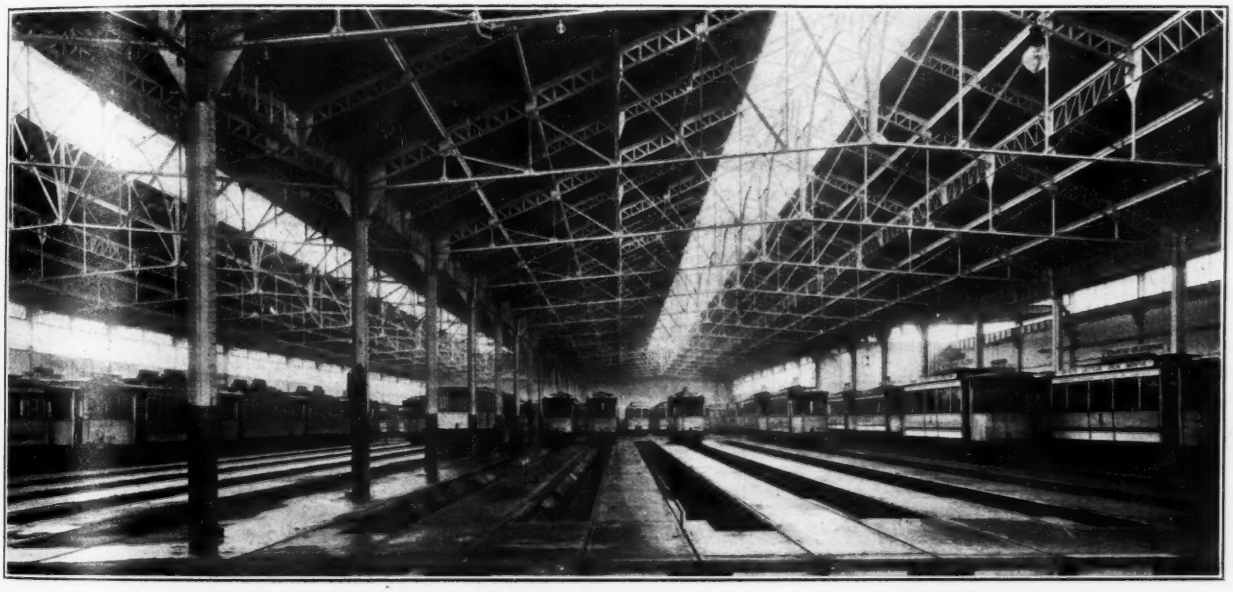
A CONCOURSE of accumulators has been held in Paris by the Minister of the Marine. The tests covered a considerable period, as it was desired to make a careful series of observations upon the leading types of batteries so as to determine which was the best adapted for the use of the marine. The accumulators were submitted to a rather severe test. The elements furnished by the competitors were placed in series and were first charged for four hours at 330 amperes. The first discharge was made at 660 amperes. A series of charges and discharges of this kind was carried out at regular intervals, and these were stopped whenever an element of the series had fallen below 1.65 volts. All the charges were made at 330 amperes, and were made so as to restore to the cell an amount of energy equal to fifty per cent above that which had been taken by the preceding discharge. The tests were carried out at the Central Laboratory. The cells were given two charges and two discharges per day, and these were carried out on a regular system. The total number of charges and discharges was to be 150, and when any element fell as low as 1.65 volts it was removed from the circuit and taken apart in the presence of the constructor and a representative of the Marine. The elements had to satisfy the conditions of maximum weight and size. Each cell completely mounted could not exceed 495 pounds. The concourse brought out as many as twenty-one different types of accumulators, furnished by thirteen makers. Of these cells there were eleven which had both positive and negative plates of the pasted form. The remainder, with but one exception, had pasted negatives, and the positives were of Planté formation. One battery had both plates of the Planté type. The tests were continued until 150 discharges had been made, when it was found that eleven of the cells still kept up the voltage required in the test. This was only one part of the test, as the cells were next to be observed as to capacity, etc. The ten elements which did not stand the 150 discharges were equally divided as to type, five being of the pasted and five of the mixed variety. Their failure was found to be due to the well-known causes such as short-circuits, generally due to falling out of material, sulphating, etc. One of the best of these accumulators seems to be the Phenix, which stood 196 discharges. After examining the cell it was found to be intact with no short-circuits or sulphating. The advantage of this cell is that it has its electrodes surrounded by a protecting sheath which prevents the material from falling, and the battery is thus specially adapted for use where shocks or vibrations are met with. In the tests of capacity the cell gave a 220-ampere discharge for eight hours two minutes, while the other types did not go higher than seven hours twenty-four minutes, and some did not exceed four hours.

Alongside of the great hydraulic plant of 10,000 horse-power which has been established at Tivoli to supply the city of Rome, there exists a small plant which possesses an exceptional interest. This plant was installed by Lucien Gaulard, in 1886, in order to make a practical test of his new alternating-current system, using series transformers. It is therefore of great historic value as being one of the first alternating-transformer plants in existence. The installation was, of course, of a rather primitive character, but was well carried out, and, in fact, a part of it still continues to light the town of Tivoli. Gaulard's old station no longer exists, as the building was taken down some time ago and the machines transferred to a new station which was erected to light the town. However, the old plant was preserved for the street lighting system, and is installed along with the new machines of modern type which have been substituted for the house-lighting. The old plant used power from the Tivoli fall and had two Girard turbines of eighty horse-power each with vertical shaft. The two turbines were connected by gearing to a main shaft placed at one end of the station and from it a pair of alternators and exciters were run by belting. The alternators were of the classic type, built by Siemens Brothers, of London, and gave a voltage of 2,000 to 2,500 with a capacity of twelve amperes, running at 650 revolutions. Back of each alternator was placed a small exciter. The switchboard was of a rather unique character, being installed on the top of a table where were grouped the different instruments of the period—a Thomson electrostatic voltmeter for the high-tension circuit, an Ayrton & Perry ammeter for the fields, a Siemens dynamometer, also an automatic field regulating device consisting of a balance arm operated by solenoids; the arm had a series of contact pins which dipped into mercury cups for putting resistance coils into the field circuit. Most of the apparatus is still to be seen in the new plant, where it is in use for the street light circuit, but the old switchboard arrangement is no longer used. The original type of street lamp is still in use and consists of a bracket generally supported on the walls of the houses; the bracket holds a lamp and shade, and above the lamp is a socket which contains a small transformer of 150 watts working at three amperes and fifty volts. The plant has also a number of large transformers up to 600 watts for the house-lighting, but these are no longer used. All the transformers are of the original Gaulard & Gibbs type; that is, an open magnetic circuit with straight or horseshoe core of iron wire surrounded by copper-strip windings. The line, part of which exists at present, is a bare copper wire 0.16 inch in diameter run along the tops of the houses upon insulators, with branch wires leading down to the lamps. This primitive plant, running alongside of the great Tivoli station, offers a striking comparison.

It seems that the projected high-speed electric railroad from Brussels to Antwerp is shortly to be taken up. The company which proposes to install the road lately made a report to the council of the Belgian state railroads and exposed the project which it expected to adopt. This report, it appears, has been favorably received. According to the present plans the trip from Brussels to Antwerp will be made in twenty-two minutes, and trains will follow at ten-minute intervals each way. The line is to be laid out as straight as possible in order to reach the high speeds proposed. The type of car likely to be adopted has a central passage and is mounted on a motor-truck at each end. The concession for the road is to last eighty-five years, the government to have the privilege of taking over the road when it wishes. During the time of the concession the state is to have forty per cent of

the net receipts, and, on the other hand, will guarantee an interest of two and one-half per cent to the stockholders; this represents $250,000 on a total capital of $10,000,000. In case the government takes over the road it will allow ten per cent of the profits to the stockholders as long as the concession lasts. It is stated that the plans of the road are now being drawn up in the offices of the Minister of Railways, and these will be finished about the end of the year. Soon after, the project is to be presented to the chambers, and when adopted the work will be carried forward rapidly, and may be finished at the beginning of the year 1904.

An extensive car barn is that which has been erected by the Thomson-Houston Company, of Paris, to accommodate the cars which are in use on the underground conduit lines. It has a total area of 15,000 square yards, and at present contains ninety regular traction cars of thirty-six places and the same number of trailers of thirty-three places, besides two electric street sweepers, making a total of 182 cars. It has sufficient capacity, however, for 225 cars. At the sides of the building are the main tracks for the entering and outgoing cars, and in the centre will be noticed the inspection tracks and their pits. Running across the ends of these tracks is a special track over which runs a truck platform used to transfer the cars. There are three of such trucks; the first two are used to shift the traction cars. Their length is 175 feet and width 23 feet, and they are operated by G. E. 800 motors, using the standard controllers. Current is taken from a rubbing contact which slides over contact rails placed along the track. The third of these trucks is used to shift the trailers and measures 152 feet long and 14 feet wide. The current is taken in this case by means of a central conduit, using a contact plow of the standard type. For the traction cars there are thirteen tracks in the middle portion, using a side conduit which will be observed, and provided with inspection pits. Outside of these are two regular tracks, also with conduit, for the manœuvres. The trailers have fifteen tracks in ordinary rail and two inspection pits. At each end of the buiding are installed the storerooms, as well as various shops for repairs, and for mounting and dismounting the trucks and car-bodies. Electric power is furnished to the shops by G. E. 800 motors which drive the different tools. For dismounting the car-bodies an electric crane of twelve tons is used. The carriage is arranged so as to lift the car-body from the truck in a rapid and economical manner, and it only requires three men to carry out the manœuvre.



LARGE CAR BARN, PARIS, FRANCE, CAPACITY, 225 CARS, EQUIPPED WITH INSPECTION PITS, STOREROOM, AND REPAIR SHOPS.

A large German plant is that which has been erected at Ludwigshapen. It furnishes light and power to the city, which has about 60,000 inhabitants; it is an important industrial centre situated on the banks of the Rhine. The station has been designed to supply the city lighting and furnish power to the various smaller industries. It is also intended to supply power to the larger establishments, and to this end it is proposed to deliver it cheaper than the cost of production on the spot. The station is situated on the river bank, and the coal can be taken directly from the boats. The boilers have been supplied by the Guilleaume works, of Neustadt, which also furnishes the superheater and accessories. The plant is equipped with three Sulzer engines of horizontal type, giving 400 horse-power each at ninety-four revolutions. The engines are direct-coupled to three-phase alternators of 350 kilowatts. In two of these generating sets there is also a direct-current generator coupled to the same shaft as the alternator. The latter have a capacity of 260 kilowatts. In the three-phase transmission the line works at 3,000 volts and the current is used for the lighting and power circuits, being lowered in different substations to 125 volts. The direct-current machines supply current for the city traction lines. By this system the engines which drive both alternating and direct-current machines are kept under good conditions of load for most of the time. The project has been carried out under the direction of Oscar von Miller, a prominent engineer, and the work of installing the plant was undertaken by the city itself, which thus realized an economy of $25,000 over the estimated expense. This sum is to be set apart for future enlargements. The electric outfit was supplied by Brown, Boveri & Company, of Mannheim, and the line system by the South German Cable Works. The municipality has decided not to operate the plant directly, but has allotted it to a company which has been formed for the purpose. The latter is to pay the city a fixed sum annually and will then run the station for its own profit.

C. L. DURAND.

Paris, France, October 25.

Notes from Great Britain.

(By Our Special Correspondent.)

OFFICIAL inauguration of electrical undertakings seem to be gradually dying out in Great Britain. Hence it is that during the past few months quite a number of installations of all sizes and descriptions have been unostentatiously put into service, and in many instances even the profession itself is hardly aware of the fact. Leaving for the moment the minor installations in small towns, attention may be drawn first of all to the undertaking of the Midland corporation for power distribution, which was the pioneer company registered for the supply of electrical energy over a large area. The fact that it has only just started operations, however, is due to several causes. Its Parliamentary powers are somewhat more complicated and more restrictive than those of the later "bulk" supply concerns, and its area of operation is scarcely so compact as it might be. This straggly nature of its area alone demands special considerations from the distribution point of view, and I believe internal causes have also contributed to a somewhat belated start. However, the company has the satisfaction of knowing that it has secured one of the best areas in the country for a business of its kind, situated as it is in the very centre of the "Black Country" and Potteries district, with the township of Birmingham practically in the middle, near which spot has the generating station been erected. The district involved is chock-full of factories, which, together with projected tramways in the locality, should provide a ready sale eventually for electricity. At present the power-house, substations and mains are completed and running on a small load. Only two 800-kilowatt and one 1,500-kilowatt Ferranti alternators have been erected, which generate two-phase current at 7,500 volts, and a fuller description of the whole equipment will be more valuable later on. Another electrical undertaking wherein an electric power supply scheme will play a prominent part is the Tyneside Tramways Company, which will be supplied with power by the Newcastle-upon-Tyne Electric Supply Company, which company's works were described at the time of their opening, early last year. The tramways will accommodate a very populous neighborhood round about the Newcastle district, and little doubt is felt as to their ultimate success.

The possibilities of electricity for power purposes in factories is being well exemplified in the northeast corner of England—up in the Newcastle district—and Mr. Snell, the borough electrical engineer at Sunderland, has come forward with a municipal power supply scheme on the lines of the companies—of which there are two quite close to him—which has provoked a good deal of unfriendly criticism from those who oppose municipal trading, although an impartial observer can hardly see any distinctive line between municipal supply for power and municipal supply for lighting purposes. Mr. Snell's scheme involves an outlay of some £70,000, and he recommends that shipbuilders and others should be offered a supply of electricity for driving workshop tools as would render it unprofitable for each firm to install its own plant. The report prepared by Mr. Snell was adopted, with only one dissentient, at a meeting of the Sunderland council.

The British Association meeting at Belfast, while productive of the usual heavy crop of ultra-scientific papers, also dealt with a number of more commercially practical contributions of current interest. Among these was one by the Hon. C. A. Parsons, on "Steam Turbines," a subject to which the author has considerably devoted himself. As a matter of fact he did not go into any great detail concerning the theory of the steam turbine, chiefly confining himself to mentioning the various uses to which the machine has as yet been applied. The 5,000-horse-power Parsons steam turbine, manufactured by Messrs. Brown, Boveri & Company, of Switzerland, was mentioned. Attention was also drawn to a recent success in driving the steam turbine in the reverse direction—I mean as a rotary pump.

The future of the telephone in the United Kingdom was the subject matter of another contribution by Mr. J. E. Kingsbury, and in which the early history of telephony—which was given somewhat fully in our "Twentieth Century Number"—was traced. Further on in the paper the author deprecates the passing of the Telephone Act of 1899, and considers the agreement between the National Telephone Company and the Postmaster-General in London superior to individual municipal competition as practised at Glasgow and Tunbridge Wells. Following up this argument the author travels on ground which has already been somewhat debated, and concludes with the hope that the subject of a telephone service in every locality may be considered solely from the point of view of the "public weal," and that scientific enquiry may have some share in arriving at conclusions. If this be the case, his own unwavering opinion is that the future of the telephone in the United Kingdom will be free from competition, free from the expense and waste of war—developed by the certainty of permanent utility—and cheapened by the economy which unity of control and permanent work will attain.

I have mentioned on several occasions the lack of courtesy displayed by makers and sellers of electrical motor cars in supplying any information regarding their goods to the press, and that this has been noticeable, even at the exhibitions. One of the leading electrical journals on this side, I notice, has met with the same discourtesy, even after taking the pains to make appointments with a number of firms with the view of describing their cars.

In no quarter of Great Britain have the steam railways been more greatly affected by electric tramways than in South Lancashire, where a close network of such lines is being gradually woven around and through all the leading towns. To make the discomfiture of the railway companies more complete, the Liverpool corporation has entered into arrangements whereby through traffic will be possible from Southport to St. Helens, quite a considerable distance in comparison with what has hitherto been done. The chief point about the arrangement is, however, the fact that three distinct systems are traveled over. One other instance, in addition to the many which have been mentioned at various times, of the financial effect of electric tramways upon steam railways may be recorded from Glasgow, where the corporation system of tramways has been instrumental

in the withdrawal by the Glasgow & Southwestern Railway Company of its suburban services to Govan and Springburn, with the exception of a few early morning workmen's trains. This is about the most drastic step ever yet taken under these circumstances, and it will probably drive home to steam railway companies more forcibly than ever the superiority of electric traction over steam traction—at any rate from the financial point of view, which, after all, is the main objective of all trading concerns.

Still on the subject of electric tramways, it may be mentioned that the London United Tramways Company continues to put new sections into operation, and that the London County Council system is being pushed forward. The last piece of horse tramway has now passed into the hands of the council from the South London company, and will be converted in due course.

The Glasgow Corporation Tramways Department has been extremely unfortunate in the matter of accidents since the inauguration of electric traction. Up to the present, however, these have been of a comparatively trivial character, but recently a most serious one happened which caused the death of one passenger, a lady; five others were seriously injured and some thirty more treated for slight wounds. The cause of the accident, so far as is known at present, was through the brake-handle coming off at the time the driver was releasing the brakes to go forward up a hill. Overbalancing himself, through the handle coming off in his hand, he had not time to recover before the car was quickly running backward, and eventually got completely beyond control. In its career down the hill it encountered another car coming up. This it quickly forced backward, and the two, with increased impetus, finally carried yet another car before them. The cars eventually left the rails, but did not overturn and no other damage was done. Of course, a Board of Trade enquiry will be held into the accident, and Major Denitt, one of the Board's inspectors of railways, has been appointed. In the meantime, Mr. John W. Young, the Glasgow corporation tramway manager, has issued a report in which he states that it was not due to negligence that the brake-handle came off, as every car is inspected before leaving the depot each day. He is unable to account for the contretemps inasmuch as both motorman and conductor were trained drivers. The conductor endeavored to apply the brakes at his end of the car but appears to have been swept off in the rush of the passengers to get off the vehicle. Further details will probably be forthcoming at the enquiry.

A typical instance of what may be expected to happen more frequently in the not distant future, is the opening of an additional electric supply station by the corporation of Sunderland consequent on the continued overloading of the original power-house. In fact, this has taken place on more than one occasion hitherto, but mostly in connection with smaller networks than that at Sunderland, which, situated in a densely populated manufacturing district, should eventually acquire a purely power load which would make the mouths of some less fortunate station engineers in more rural districts water considerably. In the boiler house of the new Sunderland works provision has been made for eight Lancashire boilers, fitted with mechanical stokers. The covering of these is a departure from that usually seen in British stations, as the partition wall between each pair of boilers is carried up above the shells, the tops being covered with chequer plates laid on light T-frames. The water softening is on the Archbutt-Deeley process. The present equipment of the engine room is two 125-kilowatt dynamos in direct-connection with Belliss three-crank, triple-expansion, marine-type, enclosed engines, running at 400 revolutions per minute, and three four-pole dynamos direct-coupled to 500-horse-power Belliss engines running at 360 revolutions. Provision is also made for two 700-kilowatt steam sets, which size it is intended in future to make the standard for the station. Mr. Snell, who is the borough electrical engineer at Sunderland, and the president of the Incorporated Municipal Electrical Association, states that a large development is gradually taking place, the shipbuilding firms now starting to throw out their obsolete plants and reverting to electricity as a motive power. This circumstance is demanding a supply at some distant points, and for this reason the building of a number of high-tension substations is in contemplation. Mr. Snell, it will be remembered, was the writer of the paper advocating two-wire as against three-wire distribution, which created a mild sensation in July, before the Incorporated Municipal Electrical Association.

The work of converting the Mersey Railway into an electrically driven line, of which mention has been made from time to time, is being proceeded with, and the contract time expires on January 15 next. The British Westinghouse Company, which is the contractor, estimates that the cost per train-mile under electrical conditions will be sixpence three farthings as against one shilling at present.

A. W.

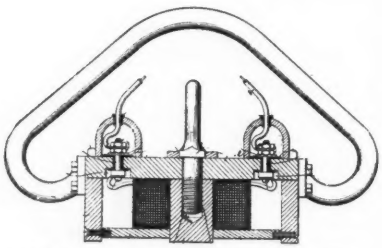
London, October 10.

Double-Current Generators and Rotary Converters.

In a recent discussion by Mr. S. Woodfield, in a British contemporary, of the subject which is at present attracting considerable attention in England, it is stated that the reason double-current generators have been so little used in England was that there was no necessity for them, owing to the limited distance of transmission required for railway work. The machine is considered as applied to the following uses: To convert alternating to continuous current, and *vice versa;* to convert alternating current of one kind to that of another, and give off mechanical power at the same time; to receive electrical power of one kind, together with mechanical power, and give off either continuous or alternating power; to give both alternating and continuous power at the same time when driven by mechanical power. The advantage of this type of machine in supplying current to railways lies in the fact that the load is automatically shifted from one side of the machine to the other without altering to any large extent the efficiency. Another point in favor of the use of these machines lies in the fact that reserve machines are cut down to a minimum. The operation of the double-current generator is then considered in comparison with that of a synchronous converter. In the latter, the armature reactions cancel each other, and in this way the output is limited by the question of commutation only. In a double-current generator, the armature reactions of the two sides of the machine do not compensate, but must be added together. In this way the output of the machine is limited by the armature heating. The effect of displaced current in the operation of the machine is discussed. The author then considers the use of motor-generator sets driven by induction motors, and claims that these machines are more stable than a synchronous machine, and therefore more reliable. Although a better power-factor and power efficiency can be obtained with a synchronous set, which makes these preferable in some cases, in double-current stations, where the pressure on the direct-current side is regulated by the field rheostat, an asynchronous machine appears preferable.

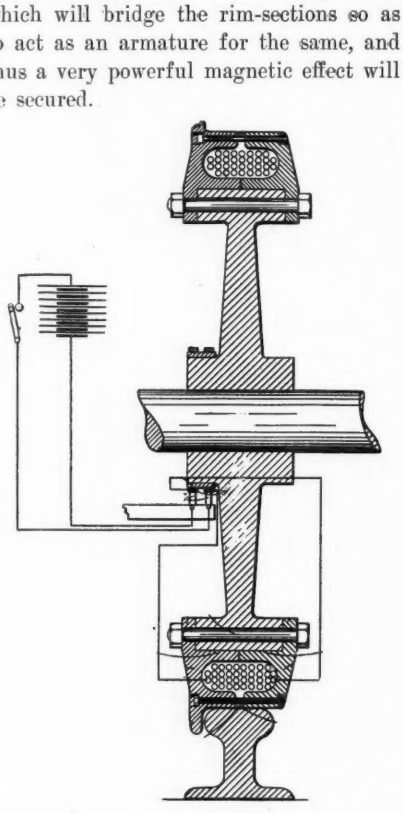
Electrical Patents

A resident of Chicago, Ill., Mr. Eugene B. Clark, has recently obtained a patent on a device for lifting metal plates in which an electromagnet is employed. The invention, however, does not relate particularly to the magnet, which may be of any desired form and construction, but to a curved yoke secured to its opposite sides and extending over the top of the magnet. A link is attached to the yoke and has a roller, which is movable from end to end of the same. The link working in this yoke is attached to the usual hook of a crane employed for manipulating the magnet and shifting the plates. Thus, if the plates are lying in a horizontal position, the magnet is applied to one end thereof and raised, thus elevating one end of the plate. As the upward movement continues, the roller of the link will slide along the yoke to one end of the magnet, so that the plate will finally assume a substantially vertical position.



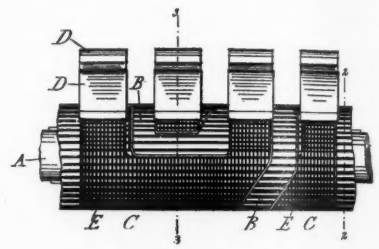
DEVICE FOR LIFTING METAL PLATES.

Mr. Barton B. Hill, a citizen of the United States, who resides in St. Petersburg, Russia, has invented a novel magnetic traction-wheel of that type wherein the magnetizing coil is arranged internally of the wheel, the latter forming practically an ironclad bipolar magnet, the rail on which the wheel tracks acting as the armature thereof. With magnetic traction-wheels of this kind, as heretofore suggested, the proposition has been made to form the wheel of the two halves, each has a channel which coincides to form a chamber for the reception of the coil. Such a device is expensive to construct and maintain and is not strong enough for practical use unless made objectionably heavy and bulky. This inventor proposes to overcome the objections referred to by using a magnetic rim made preferably sectional and which can be applied to wheels of any desired variety by first removing the flanges and somewhat reducing the thickness of the rims thereof. To this end the axle is provided with the usual hub having the web or spokes and a rim. This rim may be either cast or welded or planed to that shape from a suitable flanged wheel. The magnetic rim is made of two parts corresponding with each other, except that one is provided with the usual flange. These members tightly grip the rim of the wheel and are secured by transversely disposed bolts. In the chamber or recess formed between them is located a coil of insulated wire, the terminals of which are connected with collecting rings with which suitable brushes cooperate. A wheel as thus constructed will travel on an ordinary T-rail which will bridge the rim-sections so as to act as an armature for the same, and thus a very powerful magnetic effect will be secured.



MAGNETIC TRACTION-WHEEL.

The Sprague Electric Company, of New York city, has obtained control of a patent issued to George H. Hill, of Glen Ridge, N. J., on an important improvement in electric switches. This invention relates to electric switches, and particularly to switches of the cylinder type in which spider castings on the shaft are insulated therefrom by an insulating compound. The shaft or spindle A of the switch, here shown as of the cylinder type, is covered with an insulating compound B, so as to form a layer under and between the castings or segments C, the lugs C′ of which carry the copper contacts D. The brushes are lettered D′. The well-known way of applying the insulating compound and castings to the shaft is to string a number of rings of suitable insulating compound upon the shaft and then set and hold the castings thereupon so that they will not change their relative position to each other. This having been done the parts are subjected to heat, as by gas-jets, so as to soften up the rings of insulating compound and make them plastic. Other rings are forced on the shaft so as to squeeze the softened and now plastic material up into the interstices between the castings, and the process is continued until all of the interstices are filled with the compound, when the structure is allowed to cool off, and the exposed surfaces of the insulation and the castings are then covered with a coat or coats of paint. In the present invention the described method of assembling is also perferably used, but before assembling the castings C are enameled or japanned with some suitable insulating material E—such as porcelain, for instance. This enamel or japan is hard and baked on the castings, so that it will resist the subsequent heating when the insulating compound is applied to the shaft. The enamel or japan also provides a hard insulating skin on the castings,

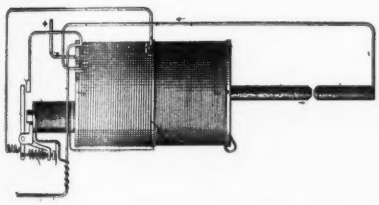


ELECTRIC SWITCH.

which is not readily broken down, and thus prevents the initial leak between the castings, and consequently the disastrous arcing which follows. A coat of paint, F, may or may not be applied to the exposed surfaces of the insulation and castings as heretofore. The painting of the castings after they have been assembled upon the shaft is not as advantageous as previous enameling or japanning, for the reasons that the paint can not be hard baked on account of the low temperature limit of the insulating compound, and is therefore not as durable, and also that the paint is liable to crack.

The General Electric Company has obtained a patent on a novel apparatus for maintaining uniform resistance in electric circuits, which is the joint invention of Frederick A. Gilbert, of Brookline, and Emil O. Lundin, of Beachmont, Mass. Normally, the feed-controlling circuit has a certain resistance, and when the current is turned on the carbons will be separated to form the arc; but after the lamp has been burning for some time the resistance of the feed-controlling circuit will in-

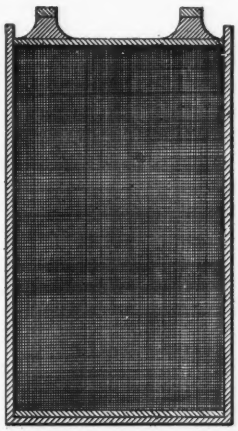
crease by the rise in temperature of the lamp. Ordinarily, the power of the feed-controlling circuit will be so reduced that the carbons will not be brought together to reduce the length of the arc until the voltage is increased very much. To overcome this objectionable feature, the present practice is to make the normal resistance of the feed-controlling circuit less than that required to attain the proper length of arc, so that the proper resistance will not be reached until the lamp has become heated, and prior to such time the arc is too short, resulting in a poor light. In another application filed by the inventors November 22, 1897, Serial No. 659,391, there is disclosed a method for maintaining the resistance substantially uniform by varying the effective extent of the resistance medium inversely to, and to compensate for the change in the resistance capacity per unit of such medium due to an extraneous cause, such as heating, means were provided for carrying out the invention when applied to an electric arc lamp by or through means, the operation of which was due to a change in temperature of the lamp. In the present invention the same result is effected in



APPARATUS FOR MAINTAINING UNIFORM RESISTANCE BY ELECTRICAL CIRCUITS.

another manner by utilizing the change of voltage in the lamp after it has been burning to either weaken the magnetic effect of the series winding or to reduce the effective resistance of the shunt winding.

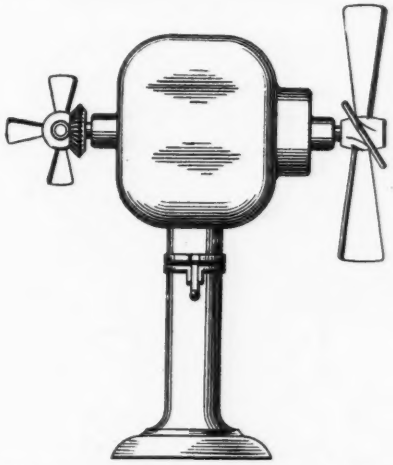
The International Battery Company, of Chicago, Ill., has obtained a patent on a storage battery invented by Mr. Frederick Sedgwick, of Chicago, Ill. The object of the invention is to so construct a storage battery as to enable the usual grids or supporting frames with their superfluous bulk and weight to be dispensed with and to provide for the ready escape of gases from the electrodes while presenting a maximum surface for exposure to electrolytic action with a minimum weight and bulk of active material. To these ends the invention consists in forming the respective electrodes from a multiplicity of exceedingly thin juxtaposed sheets, films or parallel layers of lead-foil, each film or layer having minute punctures therein of such manner and such fine comminution as distinguished from mere holes or perforations and so closely assembled as that when the films are juxtaposed either in separate sheets or as a continuous roll they may form a cellular mass, thereby imparting to the electrode the characteristics of a fine sponge or lamp-wick, so that it may not only be capable of absorbing the elec-



NEW TYPE OF STORAGE BATTERY.

trolyte by capillary action and permitting a free circulation thereof, as well as the ready escape of any gases formed, but will also present a maximum surface to be acted upon by the electrolyte. One method of and means for producing the indentations is described as follows: A steel die is provided with fine longitudinal and transverse grooves, between which are projections having minute-raised points. The film of lead-foil is laid flatwise upon the face of the die, and a piece of yielding material, preferably of leather, is placed over said foil. Pressure is then exerted against the leather either by pounding the surface or by placing the same within a suitable press, which causes the foil to become indented within the grooves. The surface of the foil is then preferably removed by means of a plane, file or other suitable tool down to the points of the die. The result is that a uniform and regular series of minute perforations is formed, corresponding in number and position to the projecting points of the die. The die should be made very fine, with not less than about sixty grooves to the inch, and preferably more. Such a die gives about 3,600 perforations for each square inch of surface of the lead-foil, and in view of the corresponding indentations in the foil it is obvious that the assembled foils would represent a wick-like cellular mass, through which a uniform and complete circulation of the electrolyte would obtain, as stated.

Mr. Benjamin Blum, of New York city, has just obtained a patent on an electric fan, the object of which is to provide a simple and cheap form of mechanism whereby the motor and its fan will be continuously rotated bodily to cause the room or space in which the fan is located to be intermittently swept by the blast of air created by the blades of the fan. The motor having a rotatable support is mounted on a pedestal or base, between which and the motor support is interposed a bearing, affording the motor a motion upon a vertical axis. The type of motor is not material, but a common form having a spherical field magnet is the type usually employed. The armature shaft extends through each side of the field magnet and carries on one end the regular ventilating or air-circulating fan and at the other end a small bevel pinion. This bevel pinion engages with a smaller pinion, mounted upon a short shaft at right angles to the armature shaft in a bearing in a bracket projecting from the field-magnet frame. The opposite end of this short shaft carries a comparatively small fan or air propeller, which is rotated by the motor at the same time the larger fan is rotated.

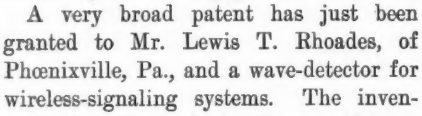


NEW FORM OF ROTATING ELECTRIC FAN.

Since the axis of this small fan is at right angles to the vertical axis of the motor, the small fan will bodily rotate the motor on its vertical axis whenever it is permitted to turn with the armature shaft. The fan motor will therefore have a constant rotary motion on its vertical axis, and the blast of air sent out by the larger fan will sweep the apartment or space in which the motor is placed at regular intervals. It is desirable, however, to be able to use a fan of this character in the ordinary way—that is, without the bodily rotation—and for this purpose there is provided means for throwing the bevel gears out of mesh when desired. This consists in making the bracket in two

parts and connecting the parts by a headed screw and a slot, so that by loosening the screw that portion of the bracket carrying the pinion can be moved outward until the pinion is out of mesh with the pinion, in which condition the small fan will remain stationary, while the larger one runs. It is also sometimes desirable to run both fans at once while the motor is prevented from turning bodily, thus creating two blasts of air flowing outward from the motor in directions at right angles to each other. To accomplish this a small sliding bolt is used which is moved upward to engage with the notch.

A very broad patent has just been granted to Mr. Lewis T. Rhoades, of Phœnixville, Pa., and a wave-detector for wireless-signaling systems. The invention relates to a device for manifesting the presence of electroradiant energy and which is extremely sensitive, reliable and not easily rendered useless. It comprises a wave-detecting device which changes its resistance under the influence of electromagnetic radiations and immediately restores itself to its normal conditions upon the cessation of the radiations, and is in its finished state in the nature of a paste. In compounding this paste or ma-



WAVE DETECTOR FOR WIRELESS-SIGNALING SYSTEM.

terial for the wave-detecting device, mild steel is employed in the form of very fine particles, and also French carbon, which has been reduced to very fine granules. To equal portions of the mild steel and carbon is added twenty per cent nickel, also in a fine state, and these ingredients are mixed with enough vaseline to make the whole mass a thick paste. This paste is then placed between metallic terminals, which are then included in the circuit of the receivers of wireless-signaling systems in the well-known relations. A mixture of mild steel and carbon with vaseline will operate as previously described, and also a mixture of nickel, carbon and vaseline will operate likewise; but the preferred composition contains the mild steel, carbon, nickel and vaseline. In place of vaseline may be used any other hydrocarbon having the thick constituency of vaseline, or, in fact, any material which is an insulator like vaseline and which has a similar constituency. Furthermore, in place of vaseline may be used numerous other materials for the purpose of supporting the metal and carbon particles in a mass resembling paste. The wave-responsive device or wave-detector here described has the property of self-restoration—that is, upon the cessation of the electroradiant energy, it returns automatically to its normal condition and does not require mechanical shock.

PACIFIC COAST NEWS.

NOTES OF ELECTRICAL DEVELOPMENT IN THE WEST.

The new plant of the Ontario Power Company, near Ontario, Cal., is now almost completed. The plant will have a capacity of 1,200 horse-power, and will be operated during part of the season to its full capacity. During the summer months, when the water is at a low ebb, the capacity will be between 300 and 700 horse-power. The company has arranged with the San Gabriel Electric Company to transfer to the latter all the electricity generated above the requirements of Ontario and vicinity. The new power-house of the company is a granite structure, sixty by thirty feet in interior dimensions, with a galvanized iron roof mounted on steel trusses. Within the power-house there are three 3-phase generators of 250 kilowatts each. These are of General Electric Company construction and generate 11,500 volts. These will be direct-connected to Abner Doble water-wheels, five feet in diameter. The exciters are also driven by Abner Doble wheels. The water used at the plant is conveyed through thirty-inch cement pipes. Along the pipe line there are ten tunnels and four inverted siphons, the siphons being made of riveted steel pipe. The water has a fall of 700 feet at the power-house. From the end of the cement conduit a pressure line, beginning with a diameter of twenty-four inches and terminating at the distributor with a diameter of twenty inches, descends to the power-house. From the distributor three 12-inch pipes, each fitted with a slow-motion valve and by-pass, lead to the respective water-wheels. From the generators the current is to be carried to a switchboard in the power-house. A brick substation is to be built on Euclid avenue, Ontario, in which are to be installed step-down transformers. From this station electricity will be transmitted throughout Ontario colony.

The new 2,000-kilowatt, direct-connected generator of the Pacific Electric Company, of Los Angeles, Cal., has been placed in operation. Superintendent Atchison said after the test: "Our new generator was not finished any too soon. We have been crippled badly for power for several weeks, but this addition will tide us over the hard places till we have the other generators in action. The power of the generators in use up to to-day did not exceed 7,500 horse-power. The new generator increases the capacity of the motive power almost one-half. We have two other generators building. All the machinery for one of them is now in the yards. It will take us sixty days to complete the first of them, and the third and largest generator will not be in operation before January 1. The generators now working will give us sufficient power for all our suburban lines, and all cars will now be run on schedule time."

Grading will commence about December 1 on the track of the San Jose-Saratoga Electric Railroad. Specifications for all the material to be used in the construction of the road and the rolling stock have been completed, but no contracts have yet been let, with the exception of one for 1,000 red cedar poles and some ties. A San Francisco firm was awarded the contract. Contracts for the other material and the stock will not be let until Manager Granger and J. W. Rea go East shortly after November 1. Then the entire stock will be purchased and shipped immediately. All the freight will come West over the Burlington, Union Pacific and Central Pacific roads, and the first cars will arrive in San Jose about February 1. In all there will be about 122 cars of supplies from the East.

A. Barmann, of Los Angeles, and Julius Aubineau and David Babbitt, of Flagstaff, Ariz., have organized a corporation to be known as the Grand Canyon Electric Power Company, for the purpose of utilizing the fall of the water of Bright Angel Creek, where it empties into the Grand Canyon of the Colorado River. The developed power will be transmitted to Flagstaff, about eighty miles distant. The survey for the line is already in progress, and initial steps have been taken for securing the necessary machinery. The amount of water power to be developed is problematical, but may be immense. Fully 4,000 feet of fall can be utilized for a head of water running from 50 to 100 miner's inches. The power plant will be located down near the Colorado River, immediately below the new hotel, to be erected by the Santa Fe Railroad Company.

The Utah County Electric Light and Power Company will soon erect a transformer house at the intersection of Main street and the Sugar Factory road, Salt Lake City. The entire current will be brought to that point.

James Tunstead has sold to the North Shore Railroad Company a portion of the Alta tract at Alta Station, Murin County, Cal., upon which the company will erect an electric power-house and transforming stations for the electric railroad.

A. P. B.

San Francisco, October 22.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Electrical Resistance of Poor Conductors at Low Temperature.

This is a study by M. E. van Aubel of the change in resistance of sulphides, particularly that of pyrites. This sulphide was in the form of prisms, and the electrical resistance was measured by a Wheatstone bridge. For ordinary temperatures the pyrites were placed in a bath of oil. For low temperatures, carbon dioxide snow was used, mixed with ether. This was constantly stirred, and enabled measurements to be made from minus seventy-five degrees centigrade to minus twenty degrees centigrade. Measurements for still lower temperatures have been made by the use of liquid air contained in a silver vase having double walls. The results show that the resistance increases continually with the decrease in temperature. The rate of change of resistance, however, decreases as the absolute zero is approached.—*L'Industrie Electrique* (Paris), October 10.

Refuse Destructors.

This is the first section of a paper by Mr. W. F. Goodrich, and considers the various types of destructors now in use and shows where these could be adopted profitably. Progress in the adoption of refuse destructors has been slow, but much has been done within the last two or three years. It is thought that many towns are much behind in the matter, although they have very readily taken up city lighting. The proper location for a modern destructor should be central, so that the haulage can be reduced to a minimum, and the plant be used sufficiently to supply power or operate deep-well pumps for the town's water supply. The use of destructors in connection with electric lighting or power plants is thought to offer the best conditions. This is particularly true if the plant has a good, steady day motor load. The importance of working at high temperature is emphasized, and it is stated that unless the temperature is kept high and fairly constant the destructor will not be successful. Moreover, high temperatures are essential for economical steam raising. The single-cell systems are then described and the disadvantages of this type pointed out, the principal one being the variation in temperature produced when charging with fresh material. The twin system, in which two or more cells are worked together, avoids this trouble. Meldrum's system is then described. In this the ash pit is divided into a number of compartments, although the grate is continuous. With this type of destructor, any operation of the grate lying over one compartment can be charged without appreciably lowering the temperature in the furnace. The percentage of combustible found in the refuse varies from twenty-five to thirty per cent original material. The use of various types of boilers in connection with refuse destructors is then considered, and it is said that the Lancashire boiler must always possess advantages over those of the water-tube type.—*Mechanical Engineer* (London), October 15.

Magnetostriction.

The action of tension upon the Wiedemann effect has been examined by Herrn. K. Honda and Shimizu for nickel, steel, iron and cobalt. When the direction of the longitudinal to the circular field is in the relation indicated by the right hand, nickel steel is twisted in the same direction, and also iron. When the circular field is constant, the operation increases rapidly to a maximum, and then diminishes. A reversal is never observed in nickel steel, even in very intense fields. When the longitudinal current increases, the position of maximum operation is slightly displaced toward the stronger fields, and is greater for steels having a higher percentage of nickel. The operation is reduced in proportion to the tension. In a nickel rod the operation is the reverse of that of iron, and the same is true for cobalt. Annealed cobalt behaves differently from cast, as the operation in the latter case is about twenty times that observed for the annealed. No reversal has been observed for nickel.—*Physical Zeitschrift* (Berlin), September.

Electrometallurgical Problems.

This is the second article in this series by Mr. A. A. Beadle, and in it the methods now in use for the reduction of lead are briefly considered. These involve two operations—roasting the ore to convert the galena into sulphate and oxide, and heating without access to air, which causes the oxidized portion to react with the unoxidized sulphite, forming sulphurous acid and metallic lead. This process is complicated by the necessity of securing very pure lead. The product must contain less than one per cent of impurities. The lead produced by this method contains all of the gold and silver which have to be extracted, either by Patterson's process of crystallization or by Parke's process, in which the noble metals are abstracted from the lead by melting this and mixing with zinc. The zinc retains all the silver from which it is separated by distillation. An electrolytic process to compete with these methods must reduce pure metallic lead and silver in a more direct way. The noble metals and some of the impurities, being electronegative to lead, must be removed first. The iron and copper might remain unreduced. A number of methods have been suggested. First, the ore is roasted and treated with water or alkaline salt capable of forming a double salt with the lead. The solution is then electrolyzed. The difficulty in this process is to secure a coherent deposit of lead, and this has not yet been done. Other methods use the galena as an anode. In a soluble salt, such as chloride or nitrate, the lead anodes crumble to pieces, and here again the lead is deposited as a sponge. Methods based upon the electrolysis of fused salts present several advantages. The voltage required is low, the conductivity of electrolyte is low, the current density may be high, and the current efficiency under suitable conditions is good. The lead can be cast directly in marketable ingots. The gold and silver can be separated before reduction of the lead is started.—*Electrical Review* (London), October 10.

Oil Motor Cars of 1902.

This paper by Captain C. C. Longridge was read at a recent meeting of the British Institution of Mechanical Engineers, England, and is a very complete

study of the various types of oil motors now in use. With few exceptions these motors are of the vertical single-acting Otto type, or are horizontal Otto's, in which the cylinder contains two pistons. The vertical position is more accessible, though the horizontal causes less vibration. The author holds that the final solution of oil motors must call for a motor having an impulse at every revolution, and he briefly describes such a machine of his own design. The advantages claimed are: The impulse every revolution, perfect cushioning and easy running, high compression and economy, and no danger from premature ignition. The consideration of fuel is very important, but has been sadly neglected. An interesting phenomenon has been observed in the use of alcohol, as it was found that the addition of water brought not only increased economy and output, but caused the motor to run more easily. The reason for this is not fully understood, although a number of explanations have been suggested. This effect suggested to the author that the addition of water to the petroleum used in these motors might increase the efficiency and improve the operation. At his suggestion Mr. C. Raine carried out a number of experiments along this line, and although the work makes no claims to great accuracy, it was shown that the addition of water to the petroleum gave an increase of power and a cooler running, and this effect was maintained until the water reached a quantity equal to the amount of oil. A larger quantity of water interfered with the sparking. Tables are given, showing the operation of various types and sizes of gas and oil engines suitable for motor cars. The author next considers the question of ignition, and here also there is room for study and improvement. As is well known, it is necessary that the amount of ignition be varied with changes in load, and a number of mechanisms to effect this result are described. The author then passes to an excellent discussion of the various parts of these motors and their operation. The various mechanisms required on automobiles are also considered and the advantages of different types brought out. The paper is a valuable contribution to the literature of automobiles.—*Proceedings of Institution of Mechanical Engineers* (London), October.

Midland Electric Power Distribution.

This is the concluding section of a detailed description of this interesting installation. The cables are of the three-conductor, lead-sheathed type. The insulation is paper, and no armor is used. They are laid at a depth of about three feet in U-shaped earthenware troughs, filled solid with pitch and covered with bricks. Where there was danger of subsidence, due to mining operations in the district, lengths of cast-iron piping are used. These are merely butted together at joints, and the joints are covered with sleeves two feet in length. Distribution takes place in three ways—directly from the substations at 200 volts, two-phase; from street transformers fed at 2,700 volts from the substations, and delivering at 200 volts, two-phase, to the consumers' networks, and at 500 volts continuous current for tramways, through rotary converters. The arrangement of the substation is described and illustrated. The high-pressure cables are not carried to the distributing switchboards, but terminate in special high-tension boards. An exception is made for the rotary converters, as here the high-pressure cables, transformers and converters are connected to one board. The converter boards are supplied with time-element cutouts, which it is possible to adjust so that there is an interval of any time up to ten seconds between the overload and the cutoff. Current is delivered to the tramways through three meters in series, to avoid errors which might occur should but one meter be used. The rotary converters are rated at 250 kilowatts each, and run at 600 revolutions, the frequency being fifty cycles. They are of the Westinghouse standard type, with a damping coil on each pole-piece, and are compound-wound. The regulation of the continuous-current voltage does not take place with the assistance of induction regulators or regulating turns on the secondary of transformers, but by a variation of the excitation of the rotaries. As the rotary fields are compound-wound, this regulation is largely automatic, but a rheostat is provided in the shunt circuit should the compounding not be sufficient. Telephone lines are carried, when overhead, on the railroad poles. The rates charged by the Midland corporation are as follows: For lighting, the consumer can choose between a flat rate of fourpence one-half penny per unit, or sixpence per unit for the first 100 hours of maximum demand per quarter, plus threepence for additional units. For power, the flat rate is three half-pence per unit, with a discount to large consumers. When the "Wright" maximum demand system is used, the charge is threepence per unit up to seventy-eight hours of maximum demand per quarter, and after that 0.825 penny per unit.—*Electrician* (London), October 10.

Costs of Electric Power Transmission.

This article by Mr. A. D. Adams gives the results of a practical application of principles to find the increased cost of electric power entailed by a transmission line. Three main factors are concerned in the cost of electric power transmission—the transformers, pole line and wire conductors. The first cost of transformers varies directly with the maximum rate of transmission, and is nearly independent of the voltage and length of line and the percentage of line loss. The pole line changes in first cost with the length of the transmission, but is nearly independent of the other factors. Line conductors, with a fixed maximum percentage of loss, vary in first cost directly with the square of the length of the transmission, and inversely with the square of the voltage. A concrete example is taken, in which the power to be transmitted is assumed to be 10,000 horse-power at 40,000 volts for 100 miles. The cost of transformers for this work will be approximately $7.50 per horse-power, making a total of $150,000 for both stations. The pole line will cost about $500 per mile, or a total of $50,000, exclusive of the cost of the conductors or the right of way. In selecting the proper size of conductor the maximum loss of twenty per cent must be allowed. This will give an average loss of probably less than fifteen per cent. The line conductors to transmit this energy must have a weight of nearly 850,000 pounds, which, at fifteen cents per pound, will cost $127,500. The combined cost of the transformers, pole line and line conductors amounts to $327,500. To this $12,500 must be added to provide for transformer stations, switchboards and measuring instruments, bringing the total figure up to $340,000. The cost of the line losses is next considered. The efficiency of the transformers is taken to be ninety-eight per cent at full load, or an average of ninety-seven per cent for the day. The efficiency of the line is given as eighty-five per cent, making a final efficiency of the system of two sets of transformers and line about eighty per cent. For repairs, maintenance and depreciation ten per cent is allowed on the cost of the system, and five per cent for interest, making an annual expense of $51,000. Management, labor and incidental expenses are set down as $15,000. It has been found that electric stations working twenty-four hours daily on mixed

loads will deliver energy to an amount represented by the necessary maximum capacity during 2,400 hours per year. Applying this rule to the present case, the energy delivered yearly is assumed to be 24,000,000 horse-power-hours. The total cost of operating the line has been shown to be $66,000, which, divided by 24,000,000, shows the cost of energy transmitted to be 0.275 of a cent per horse-power-hour, exclusive of the first cost of energy. On the basis of 3,000 hours as the ordinary working time per year, the yearly cost of this transmission is $8.25 per horse-power. To this must be added the cost at the generating station of one and one-quarter horse-power. The cost of one horse-power-hour at the station is taken to be 0.5 of a cent, so that for a working year of 3,000 hours the total cost of energy delivered will be $27 per horse-power. The author then considers the effect on this figure of increasing the distance transmitted to 150 miles, and it is shown that other things remaining constant the cost per horse-power-year will be $29.25. This can be reduced by raising the voltage. Thus, a line 150 miles long, operating at 60,000 volts, will require no more copper than one at 100 miles long at 40,000 volts. The only additional item of expense to be considered would be the increase in the pole line. Assuming such a condition, the cost of delivered energy is found to be $27.65 per year of 3,000 hours on a 150-mile system at 60,000 volts.—*Cassier's Magazine,* October.

An Asynchronous Generator for Polyphase Currents.

This machine was suggested by a study of Le Blanc's self-exciting generator which, as is well known, draws its exciting currents from the distributing network. The theory of this new machine is described by M. L. Gratzmiller in this way: Consider first an alternator having two salient poles and wound for polyphase currents. Let the armature be wound for a continuous-current machine. If this be revolved at a certain speed and the brushes also revolved, but at a different speed, the machine will be self-exciting if the brushes are connected together through condensers or inductances. If the brushes are closed upon non-inductive resistances, the flux due to the armature reaction is displaced ninety degrees from that of the resultant flux, and this is true whatever the position of the brushes. In order to have a component in the direction of the resultant flux so that the machine may be self-exciting, it is necessary to introduce capacity between the brushes if they revolve, by reference to the resultant flux, in the same direction as the armature. If the brushes revolve in the opposite direction to that of the armature, when referred to the resultant flux, it is necessary to add inductances between the brushes in order to have a component in the same direction as the resultant flux. This arrangement is entirely comparable to the effect brought about by shifting the brushes of the shunt dynamo against the direction of rotation. In this case there will be a component of the armature reaction in the direction of the field flux. The author considers the case of a three-phase induction motor in which the rotor has been replaced by the armature of a direct-current machine, and three brushes placed 120 degrees apart on the commutator are connected through inductance coils. It is shown graphically that when the brushes are revolved at a less speed than that of the armature, a component of the flux, due to the armature reaction, will be in the same direction as the resultant flux, and the machine will therefore be self-exciting. The same effect can be produced if the brushes are revolved more rapidly than the armature and the inductance coils replaced by condensers, but this is not as convenient as the first. A machine has been constructed of this type and it was found to behave just as had been expected. A complete test of this machine has not been made. —*L'Industrie Electrique* (Paris), October 10.

The Bremer Arc Light System.

Until recently improvements in electric lighting have been made by electrical engineers alone. Now, however, chemists are attacking the problem and achieving notable success. This new arc lamp described by Herr S. Saubermann, is one of a number of recent developments in this field. Other lamps of this character are the Osmium and Nernst lamps, Voelker's carbide lamp and the electrolytic arc lamp of Rasch. The Bremer lamp differs from the others in having its carbons set at an acute angle, and in the use of an electromagnet to deflect the arc. Besides these details of construction, the carbons differ from those usually employed in having about twenty per cent of metallic salts mixed with the carbon of the electrodes. These consist of halogen compounds of silicon dioxide, calcium dioxide, potash, alumina, borax, magnesia, bromine and silicates of calcium sodium. The more infusible of these greatly increase the luminous intensity of the lamp, while the more fusible constituents protect the carbon from rapid disintegration. These lamps give about three times the light output of that of the usual direct-current lamp, and this is explained by the fact that the passage of the current between the two poles carries materials of the electrodes which the high temperature and the electrolytic action bring to a white heat. Spectrum analysis shows the lines of the metals, and not the bands of the corresponding compounds. The arrangement of the carbons and the effect of the magnet give a large fan-shaped electric flame of extraordinarily high light power; and although the arc is long, its resistance is no greater than that of the usual lamp, as these glowing oxides are good electrical conductors. The lamp consists of two carbons held in tubes inclined at an acute angle, a reflector, an electromagnet and a small metallic igniter. The operation is as follows: The magnet has a differential winding. When the circuit is first closed no current passes through the series coil, as the carbons are neither in contact with one another nor the metallic igniter. The action of the magnet releases simple clutches which allow the carbons to slip down in their tubes. At the same time, the magnet draws upward the metallic igniter, which short-circuits the two carbons. A current at once passes, and this flowing through the series winding of the magnet overcomes the differential winding, drawing the clutches in and holding the carbons fast, and at the same time allowing the igniter to fall away. The arc is thus established, and the weak magnet blows it out into the characteristic fan shape. The lamp burns for about twenty minutes before it is necessary to feed. By this time the increased length of the arc has so lowered the series current that the differential coil again comes into action, and the same process is again gone through. The light of the lamp is a very good gold yellow, and it is particularly rich in orange and red rays, although the blue and violet are not lacking, as shown by the photographic effects. These rays, however, are masked by the orange and red. The economy of the lamp is shown by tests made by the author and Professor Wedding. A nine-ampere lamp, taking forty-four volts at the arc, has a mean hemispherical candle-power of 3,200 and a maximum of 4,800. The specific efficiency is 0.124 watt and the effective efficiency, allowing for eleven volts drop in the windings, is 0.155 watt per candle. Distribution curves show excellent characteristics. The lamp is not suitable for interior lighting, but is exceptionally good for outside illumination. The predominance of the red and orange rays is a valuable feature in marine lighting. A notable feature of this lamp is the ability to change the quality of the light by varying the metallic constituents, and it is noteworthy that this great advance in electric lighting has come about through the aid of the chemist.—*Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereines* (Vienna), October 10.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Motor-Driven Machine Tools.

Electrical machinery has produced great changes in the art of manufacturing, and not the least important part of this change is that which it has wrought in the driving of machine tools. Manufacturers are installing, in every instance it is possible, a direct-connected electrical unit, doing away with countershafting and belting, effecting a very great economy in floor space and convenience in manipulation.

During a considerable period of the development of the direct-connection of motors to manufacturing implements, there seemed to be no common ground upon which the electrical engineer and mechanical engineer would take a stand to effect the merging of ideas for the common good of a single piece of apparatus. A number of manufacturers of electrical machinery were building a motor which would perform successfully under certain conditions of operations, and its application to the machine was one practically of chance judgment. Again, the mechanical engineer would design and construct a piece of machinery, the application of an electric motor being a secondary consideration, with the result that the great efficiency which was recognized as possible through the application of electric motors to machine driving was realized in but very few cases.

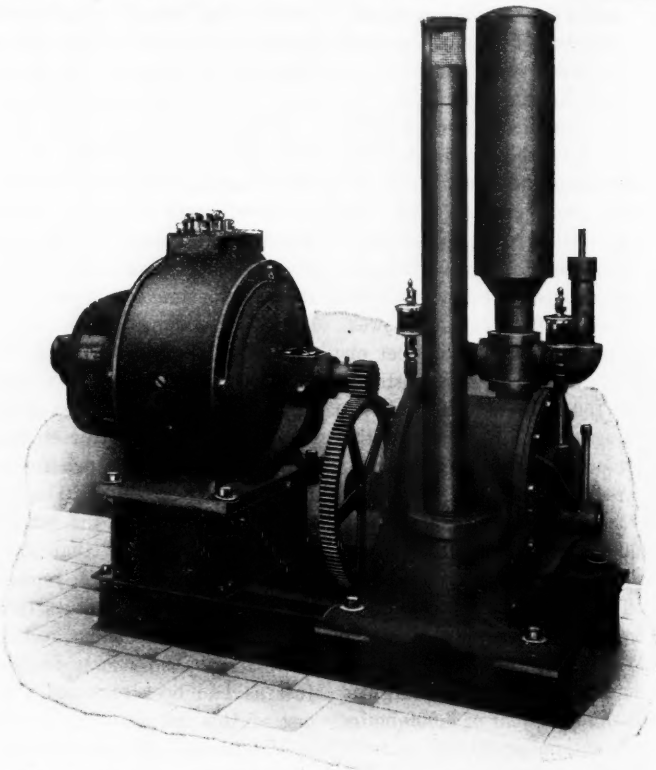


FIG. 1.—MOTOR WITH GEARED SHAFT, DRIVING PRESSURE BLOWER.

FIG. 2.—MOTOR DIRECT-CONNECTED TO BAND SAW.

Quite recently, however, there has been a progressive cooperation between the machine builder and the electrical designer, with the result that several manufacturers are now constructing the motor according to specifications which will absolutely fit the design and range of operation of the machine to which the motor is to be applied. One of the greatest difficulties which has attended the application of motors to machine operation has been the wide variation in speed required for many

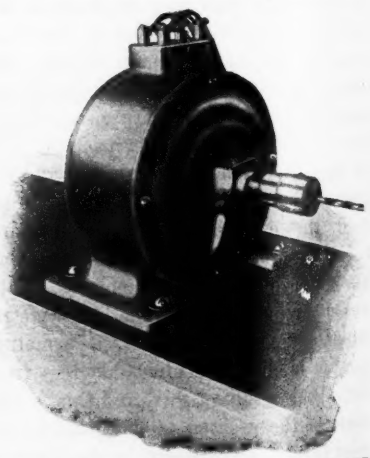


FIG. 3.—MOTOR PROVIDED WITH CHUCK FOR REAMER OR BURRING TOOL.

types of apparatus. This has been admitted on every side to be a serious difficulty, particularly in applications to light, rapid-running machinery, such as tapping machines, bolt-cutters, pipe-cutters, pipe-threading machines, power shears, emery-wheels, buffing apparatus and the like.

All these difficulties are now receiving the direct attention of many minds, and the electric motor, as adapted to an innumerable list of applications, is demonstrating continuously its superiority to any other form of driving. A glance at the list of applications which prominent manufacturers are now making to machine operation would show that almost every condition of service, covering every range of speed and variety of pressure, is being met by the electric drive.

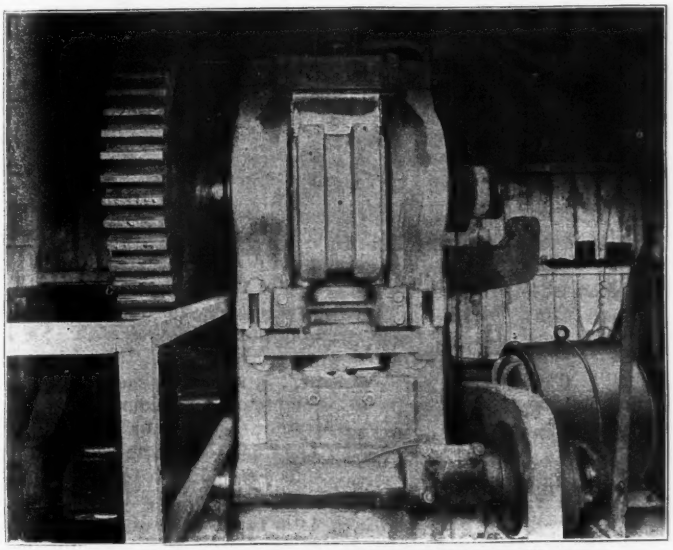


FIG. 5.—MOTOR DRIVING RAIL CUTTER IN STEEL WORKS.

The accompanying illustrations show a few of the applications of the standard type of motor manufactured by the Western Electric Company, Chicago, Ill. These are, in almost every instance, a type of enclosed motor, with drum-wound armatures, which are built in accordance with the practice which this company has found to best suit the requirements for an unlimited range of service. The cores are laminated and ironclad. The machine is thoroughly ventilated and the coils are form-wound, all being exactly similar and thoroughly insulated individually before being placed on the armature. The commutator, which is made of the best hard-drawn copper, is well insulated with a high grade of mica of ample proportions. The poles are laminated, and the coils are held in position by extensions of the pole-tips.

A special feature of these motors which distinguishes them as exclusive with this manufacturer is that they have mica windows in the commutator end covers. These serve to keep out any dust, which is a difficulty that obtains in almost every form of machine operation. At the same time, these are sufficiently transparent to indicate any serious sparking to the attendant in charge. This is a valuable feature for motors in this service, as in such operation there is a likelihood always present of the brush-holders, either through accident or carelessness, becoming so disarranged that bad sparking may result. Referring to the illustrations, Fig. 1 shows a motor with geared shaft attached to a pressure blower, the motor speed

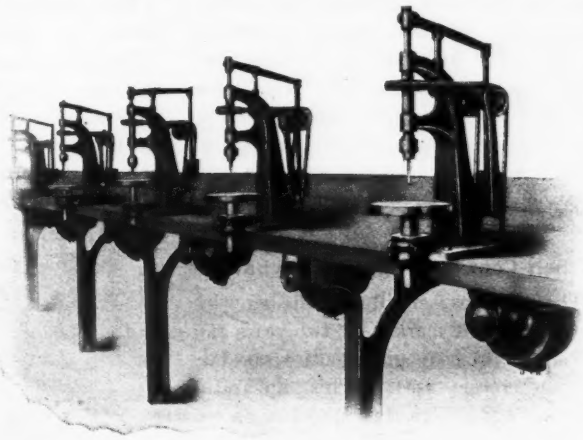


FIG. 4.—SMALL MOTORS DRIVING BENCH DRILLS.

being 1,150 revolutions per minute and the blower speed 220 revolutions per minute. Fig. 2 is a small motor direct-connected to a band saw, the motor speed being 550 revolutions per minute. Fig. 3 is a small motor, the shaft of which is provided with a chuck to be used as a burring machine, running at a speed of 775 revolutions per minute. Fig. 4 shows a group of small motors driving bench drills. The convenient application of the electric drive to these machines is very readily shown and can not fail to be appreciated by any one who has had any experience with overhead shafting, countershafts and quarter belts which obtain in this service. Fig. 5 shows a heavier motor direct-connected to a rail-cutter in the works of the Shickle, Harrison & Howard Iron Company, East St. Louis, Ill. Fig. 6 shows the application of an enclosed motor to a sand mill in the works of the same company.

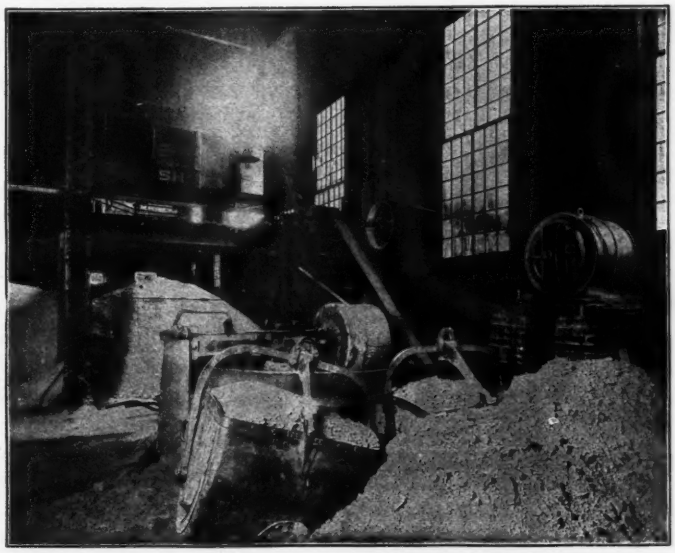


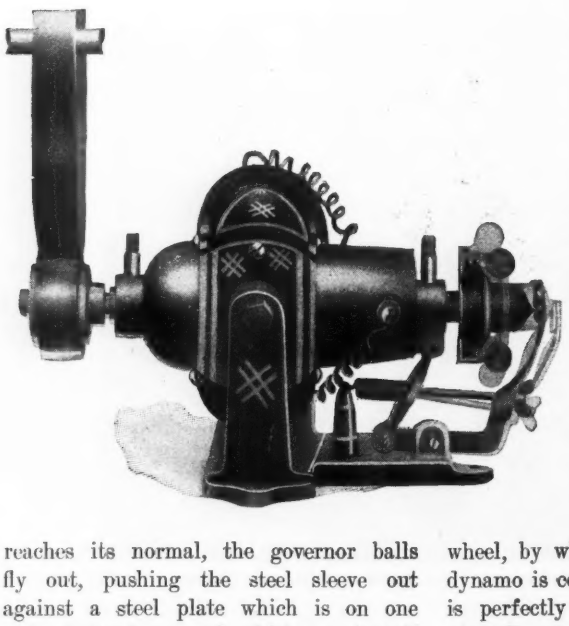
FIG. 6.—MOTOR BELTED TO SAND MILL IN STEEL WORKS.

Machine driving by means of a motor

geared to the tool furnishes a positive drive necessary to a great many applications in steel cutting, while the circuit-breaker can be relied upon to constantly reckon with any serious derangement which might affect the tool. This takes the place of the slipping point which is necessary in so many belt-driven applications, and which no doubt entails a considerable loss in any case where it is employed.

A Self-Contained Ignition Dynamo.

The auto-sparker illustrated herewith has been on the market for two years and is claimed to have given entire satisfaction wherever used. This apparatus makes it possible to start and run an engine entirely without a battery by running at normal speed while turning the engine by hand. After the engine is in motion the governor on the shaft of the auto-sparker controls its motion and prevents it from running too fast. In order that the dynamo will run only at its normal speed, in turning over the flywheel a small friction wheel is used. This is of such dimensions that it will run the dynamo at full speed when the engine is turned slowly by hand to compress the gas in the cylinder. When the engine takes the first explosion and finally goes up to its full speed, unless properly regulated, the dynamo will run from 6 to 20 times as fast as it should. This is prevented and regulated by a governor on the end of the armature shaft. By referring to Fig. 1, this is seen to run from end to end. When the speed of the shaft



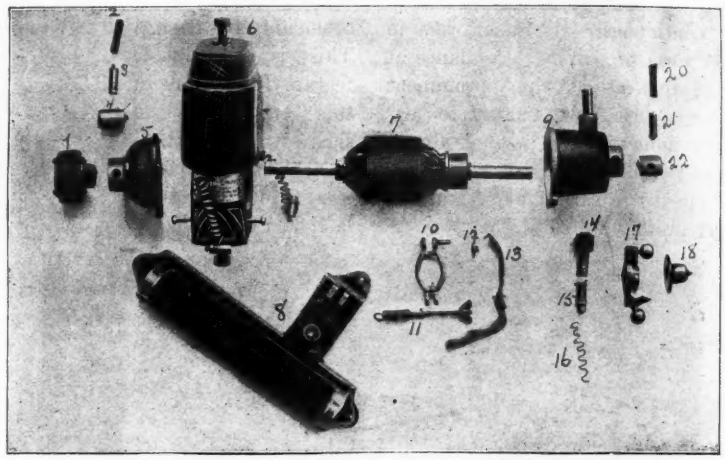
reaches its normal, the governor balls fly out, pushing the steel sleeve out against a steel plate which is on one end of the lever and which is pivoted. This causes the other end of the lever to rise up, and being connected to the body of the machine it raises one side of the machine up.

The machine maintains a constant speed, no matter what the diameter of the flywheel or the speed of the engine may be. The spring serves the double purpose of pushing the friction pulley against the flywheel and acting as a tension on the governor. By tightening or loosening the screw the speed of the auto-sparker is increased or diminished, which in turn increases or diminishes the size of the spark.

Fig. 1 shows in shadow the two positions the machine assumes. The action of the governor may be reversed so as to raise the pulley up instead of down in cases where it is necessary to use the machine on top of the flywheel, as is often the case in boats and automobiles.

In the construction of the friction pulley the best hard compressed paper, made under forty tons' pressure in combination with wood fibre, is used. Since the friction pulley is placed in contact with the polished iron, it has great traction and durability, and wears smooth, keeping its shape.

The auto-sparker is pivotally mounted on its base so as to allow for slightly imperfect flywheels and to allow the action of the governor and spring, forcing the pulley out of or into contact with the flywheel, by which action the speed of the dynamo is controlled. When the dynamo is perfectly set, the tension spring is pivotally strained about one-tenth of an inch and constantly held in this position by the contact of the friction pulley with the flywheel. When the thumb-nut is unscrewed to its last thread, the speed of the dynamo is about 600 revolutions per minute, and the amperage is about one, with the voltage at about three. By screwing down the thumb-nut, the position of the auto-sparker is unchanged, but the contact of the pulley and the tension of the governor are increased until a speed of 1,200 or 1,300 revolutions per minute may be had. Fig. 3 gives a good idea of the parts which enter into the construction of the auto-sparker. The friction pulley is shown at 1; 2 is the oil wick; 3, the oil tube; 4, bronze bearing; 5, small cup cover; 6, field and coils complete; 7, complete armature; 8, frame; 9, large cup cover; 10, link cover. The tension spring for the governor is shown at 11, the tool-steel button at 12, lever castings at 13, brush-holder tube with rubber bushing at 14, gauze brush at 15, bronze wire spring at 16, and governor with poles complete at 17. The cone and steel point are shown at 18, the oil wick and oil tube at 20 and 21, and the bronze bearing for the opposite side at 22.



This auto-sparker is not a magneto, but a magnet of special soft cast iron is used, which is wound with supersaturated fields. The armature is made of soft laminated steel fibre, insulated and waterproofed with shellac. The laminations are held in place by brass nuts, and the whole is mounted on a one-half-inch shaft, having one and one-quarter renewable bearings of phosphor-bronze. The shaft is made extra heavy in order to withstand the roughest service. The commutators are well wound and insulated with a high grade of mica, and the brushes used are round special gauze, held in place with phosphor-bronze springs.

The springs and brushes are thoroughly insulated by heavy hard rubber bushings three-quarters of an inch in diameter. The oil cups are provided with felt wick oilers which have proved very reliable in use.

This machine is manufactured by the Motsinger Device Manufacturing Company, of Pendleton, Ind.

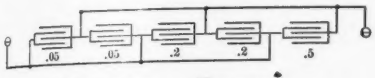
CORRESPONDENCE.

A Reply from Mr. Dobbs.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

Referring to the criticism of Mr. Arthur Graham, in the ELECTRICAL REVIEW of last week, it is to be regretted that Mr. Graham did not read the article in question more carefully, as his error is based upon a misconception of what was really said.

In the first place, the box, shown in Fig. 188, has six plugs connecting the condensers, as shown in the following diagram:



CONDENSERS IN MULTIPLE.

Now in this outline plan, our friend can not surely claim that the condensers are short-circuited; if there is a short-circuit the box should be sent back to the repair shop.

As the capacity of condensers in multiple is the sum of all the capacities, then it follows that the total capacity of the box shown in Figs. 188 and 189 must be:

.05
.05
.2
.2
.5
1.00

which is a simple sum in addition of decimals.

As to Fig. 189 it differs from Fig. 188 in that there are but two plugs set, and they at the extreme ends, thus placing all the condensers in series, and in the article it was expressly stated that the capacity of condensers in series is the reciprocal of the sum of the reciprocals of the various capacities, and also that connected, as shown in Fig. 189, the capacity, by the above rule, is but 0.019 microfarad and not 0.5 microfarad, as Mr. Graham supposes.

By the way, where does the short-circuit come in Fig. 189? Surely not through the cross-connecting strips which are separated from the bus-bars by quite an appreciable space of air and the strips mounted on the best hard rubber.

Nor does it seem reasonable that the plugs would be short-circuited by the condensers, since manufacturers generally subject these to a breakdown test of from 500 to 1,000 volts.

It is possible that the writer in preparing the article did not make all these points clear, but we are all liable to lapses occasionally.

A. E. DOBBS.

The National Electric Lighting Association.

Interest in the National Electric Lighting Association seems to be steadily increasing, and besides applications actually received, there have been many promises from companies that they will become members before the end of the year.

The membership having expressed an almost universal desire to have the arc-lamp test continued, a letter has been sent out asking for voluntary contributions to a special fund for this purpose. This is being liberally responded to, and work will be resumed in a short time. It is stated that if subscriptions continue to come in as generously as they have up to the present time a very valuable report will be presented at the next convention. The following companies have recently joined the association:

Evanston, Ill.—Evanston Electric Illuminating Company.

Hoosick Falls, N. Y.—Hoosick Falls Electric Company.

Crookston, Minn.—Crookston Waterworks, Power and Light Company.

Eureka Springs, Ark.—Citizens' Electric Company.

Portsmouth, Ohio—Portsmouth Street Railway and Light Company.

Meridian, Miss.—Meridian Light and Railway Company.

Little Falls, Minn.—Morrison County Electric Light, Heat and Power Company.

Westport, Ct.—Westport Water and Electric Company.

Zanesville, Ohio—Zanesville Electric Light Company.

Morton, Pa.—Faraday Heat, Power and Light Company.

Dover, N. H.—United Gas and Electric Company.

Monett, Mo.—Monett Electric Light, Power and Ice Company.

Branford, Ct.—Branford Lighting and Water Company.

Sumpter, Ore.—Robert E. Strahorn.

Harve De Grace, Md.—Havre De Grace Electric Company.

Eaton Rapids, Mich.—Citizens' Electric Company.

Taylorville, Ill.—Taylorville Electric Company.

Washington, Pa.—The Washington Electric Light and Power Company.

Fort Collins, Col.—The Larimer Light and Power Company.

Janesville, Wis.—Janesville Electric Company.

Waynesburg, Pa.—Waynesburg Electric Light and Power Company.

Antigo, Wis.—Antigo Electric Light Plant.

Key West, Fla.—Key West Electric Company.

Quebec, Province of Quebec—The Canadian Electric Light Company.

Ashland, Ore.—Ashland Electric Light and Power Company.

Kalispell, Mont.—Big Fork Electric Power and Light Company.

Streator, Ill.—Streator Gas and Light Company.

Cheyenne, Wyo.—Cheyenne Light, Fuel and Power Company.

Hoquiam, Wash.—North Shore Electric Company.

Madison, Ind.—Madison Lighting Company.

Lewistown, Pa.—Lewistown Electric Light Company.

Dayton, Wash.—Dayton Electric Light and Power Company.

Connellsville, Pa.—The Electric Company.

Pittston, Pa.—Citizens' Electric Illuminating Company.

Erie, Pa.—Erie Company.

Batavia, N. Y.—Consolidated Gas and Electric Company.

Georgetown, S. C.—Georgetown Electric Company.

Pipestone, Minn.—Pipestone Light, Heat and Power Company.

Newport, N. H.—Newport Electric Light Company.

Pine Bluff, Ark.—Pine Bluff Light and Water Company.

Roanoke, Va.—Roanoke Railway and Electric Company.

Power Station Additions.

The Rhode Island & Suburban Railway Company is making extensive additions to its power station on Eady street, Providence, R. I. The plant now building was originally designed for a rated capacity of 7,500 horse-power, but recently the company decided to largely augment its power equipment and contracted for a vertical cross-compound Corliss engine designed for a maximum capacity of 6,600 horse-power. The cylinder dimensions of the engine are 42 and 86 inches diameter with a stroke of 60 inches. The engine will be approximately 35 feet in height and will be direct-connected to a 2,500-kilowatt, 600-volt, direct-current railway generator, mounted between the main bearings, together with a flywheel 24 feet in diameter and weighing 125 tons. In encouragement of the proposed legislation upon smoke prevention the Rhode Island & Suburban Railway Company has contracted for a complete equipment of mechanical draft and Roney mechanical stokers for the 5,400-horse-power boilers which the new station will contain. Provision for the greatly increased boiler capacity will be made by the addition of a second story to the boiler house for the accommodations of the upper-deck batteries. All this apparatus will be supplied by Westinghouse, Church, Kerr & Company.

MODERN PRACTICE IN THE MAKING OF ELECTRIC LIGHT FITTINGS.

BY NORMAN MARSHALL, M. A. I. E. E.

THE development of electrical manufacturing, its marvelous expansion and strenuous competition tend constantly toward specialization.

The old parent companies, with whom the writer learned his first lessons, made everything from a lamp to a generator, from an underground conduit system to a socket, all under one roof and almost in one room.

From this condition has developed the manufacturer making only one small line of very similar articles, with perhaps two exceptions, which are large companies, doing practically the same thing by dividing their business into departments, making a combination of little shops, each one doing its particular class of work.

Competition and the consequent reduction in prices of electric lighting supplies have been largely responsible for the necessity of this specialization. The writer remembers when incandescent lamp sockets sold for $1.25, whereas better sockets now sell at twelve to sixteen cents.

The fact of the existence of the younger manufacturers in competition with the old parent companies is evidence in itself of the economy of this specialization, though there are but few survivors of the numberless companies that have embarked in the manufacture of incandescent fittings; the elimination of all those concerns lacking the elements of success has been swift and sure, owing in part to the rapid changes and development in methods; the greater portion of the reduction in costs having been in the processes of manufacture, requiring peculiar alertness, mechanical inventive faculty and knowledge of machinery and materials.

The design of the different parts entering into the manufacture which, in a broad sense, can be considered part of the process is also an important factor in the present efficiency. Whereas, a few years ago the greater portion of all the small metal parts were made on hand machines more or less affected by the skill and care of the operator, at the present time in the shops of the Marshall-Sanders Company nearly all parts which are used in considerable numbers are made by power machinery, the product being unaffected by the skill or otherwise of the operator.

The problem of automatic machinery, however, is a somewhat more complicated one than might at first sight be supposed. In many cases the cost of the machinery and the greater cost of its maintenance (all automatic machinery requiring the constant attention of high-priced skilled mechanics) would seem to render the employment of such machinery of doubtful value. Over against this, however, is set to advantage the elimination of the personal element—the operator and the consequent uniformity of product which can not be obtained by hand operations.

Added to this is the greater capacity of the machinery for a given floor space, which reduces the rental expense, a considerable item in the central district of Boston, where the works described in this article are located. It also renders the manufacturing establishment more flexible in that orders for large quantities can be put through in very much less time than is the case with hand operators.

In pursuit of this policy, which the writer believes to be the correct one at the present time in this line of business, he has completely remodeled the manufacturing methods in this plant during the past two or three years. As an instance of this, automatic screw machines, less than three years old, were displaced and sold at a small fraction of their cost to

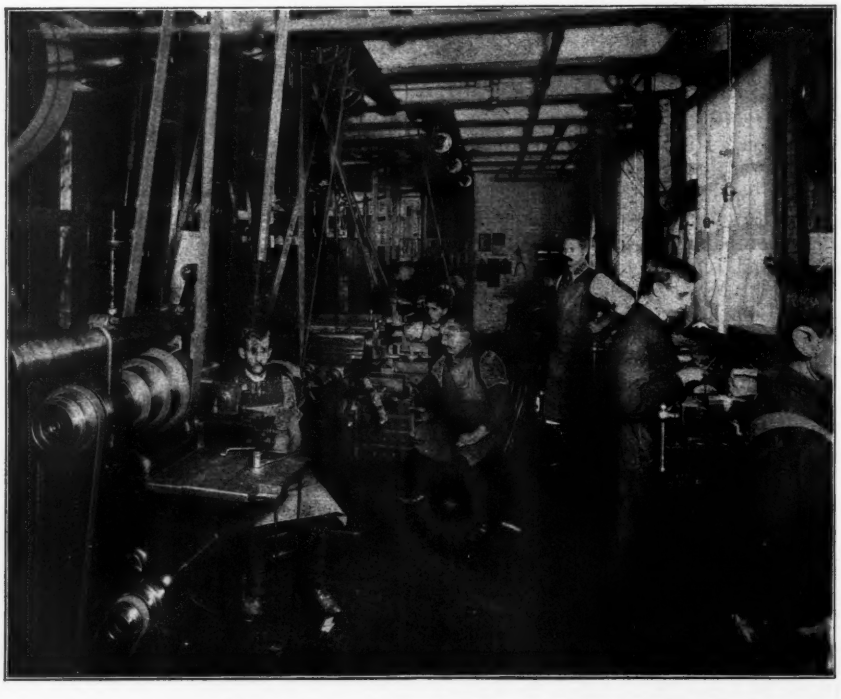


FIG. 2.—TOOL-MAKING ROOM, MARSHALL-SANDERS WORKS, BOSTON, MASS.

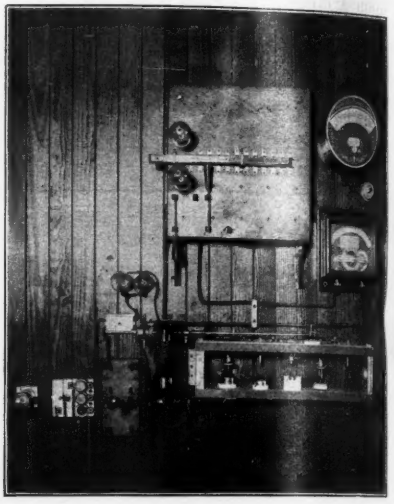


FIG. 1.—SWITCH AND SOCKET TESTING MACHINE.

FIG. 3.—GROUP OF NINE BLANKING PRESSES.

make room for other machines of a newer and more efficient pattern at a seemingly extravagant cost, and experience so far

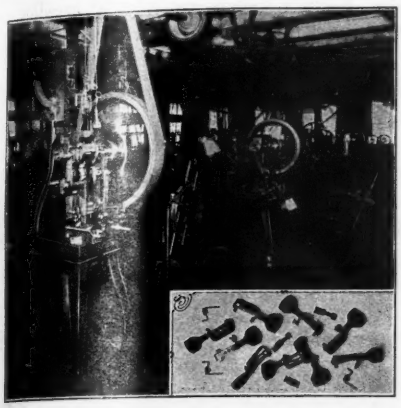


FIG. 4.—AUTOMATIC PRESSES AND PRODUCT.

has demonstrated that the increased production and the greater accuracy of the product, smaller loss from defective parts and saving in assembling, will pay for this outlay in something less than a year; in addition, as above stated, the final product is of a better quality and can therefore be sold for more money or with less selling expense.

Of course, in getting at these facts, it is of prime importance that the cost system of a factory be exact and of such a nature as to make a ready analysis of all elements practicable. The lack of such a system may account for the many failures in this line, and also for the existence of some concerns now in the business in a very small way, who entered the field upon the false assumption that the cost of a socket is made up of the primary cost of the materials and labor, neglecting amounts required to cover general and contingent manufacturing expenses, patent litigation, selling costs and the very large item of defective and unsale-

FIG. 6.—STANDARD GAUGES.

able product, which a new concern without adequate experience and engineering facilities produces. The fact that practically all electrical fittings are covered by numerous patents, together with the halo still surrounding the word "electric," have created an impression among people unfamiliar with the business that unusual profits are easily made. Whereas, on the contrary, although the business is a profitable one to those having the needed skill and experience, the strenuous competition, the peculiar and varied knowledge and organization required render it one of the most difficult lines for a new firm to enter, and show a balance on the right side of the ledger, and one of the easiest in which to lose thousands of dollars within an incredibly short period of time. It is doubtful, in fact, if with a well-regulated shop, by ordinary methods, sockets and switches could be manufactured at a shop cost equal to the present selling price of these goods, leaving out all general expenses and selling costs, a profit only being made by the special patented machinery which is used in such plants as the one described in this article.

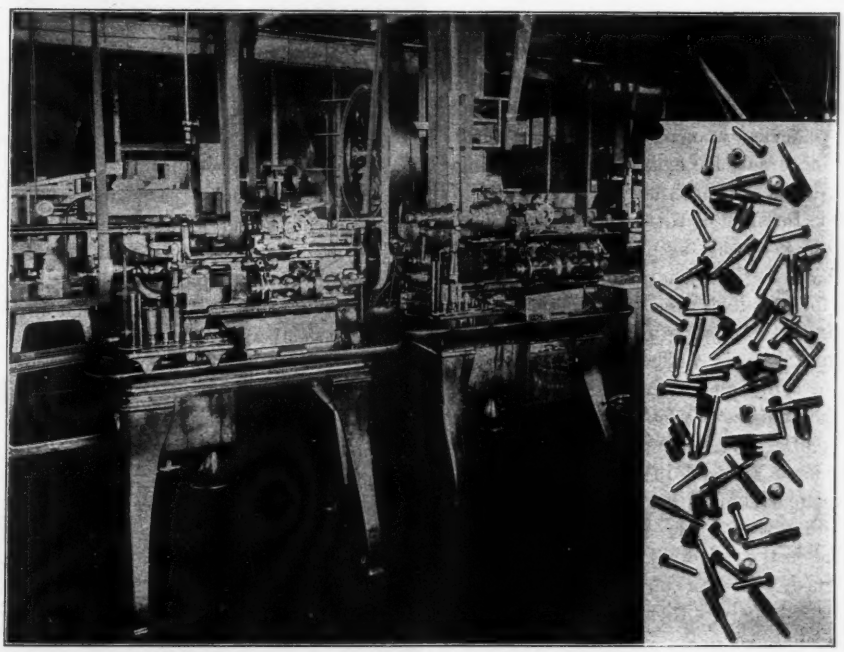


FIG. 5.—AUTOMATIC SCREW MACHINES AND PRODUCTS.

The works of the Marshall-Sanders Company are situated at the corner of Congress street and Dorchester avenue, Boston, Mass., adjacent to the South Terminal Railway station, within sight of the south freight yards and steamship wharves, and looking directly over Fort Point Channel and Boston Harbor, a particularly fortunate position for receiving raw material and shipping the finished product.

Electric power only is used in driving the machinery, and the building is lighted by electric lights.

Having thus briefly outlined the general proposition involved, it may be of interest to follow in more detail some of the methods employed.

The first process in manufacture is of course the design. The article is then perfected on the drawing-board, so far as possible, after which working models are made, and correction of defects thus discovered is made in this way. The final model is then tested, if it is a device of moving parts like a switch or socket, on a machine for that purpose, one of which is shown in Fig. 1. The article is operated in this machine as nearly as possible under the conditions which it will receive in ordinary use, being run until it gives out, thus developing the weak point in the mechanism, contacts or insulation. A record is kept of the number of turns, the current and voltage supply, and the defects developed.

Other models are then tested in the same way until the design, as corrected by this experience, is found to be above the requirements of the underwriters, and seems likely to stand in the estimate of the engineering department all practical uses to which such a device is likely to be put.

The next step is the designing and making of the special tools or machines by which the different parts of the mechanism are to be made. This is one of the most important and most difficult parts of the business, as one tool may be made with fairly good design, which, as an illustration, we will say would produce 20,000 pieces per day from a given cost

of metal, whereas, a second tool, costing no more to make, may be made to produce 40,000 pieces in a day, with a cost for metal perhaps ten per cent less than the first tool.

Obviously, the firm that can design and operate the latter class of machinery and tools, while his competitors are doing their work with tools constructed on the first plan, is the one that will make the greater profits and eventually control the desirable part of the business, provided, of course, his selling and other facilities are equal.

Fig. 2 shows a view of part of the tool-making room where all the special dies, tools and machinery used in connection with these products are made. This room is equipped with tool makers' engine lathes, precision lathes, shapers, universal milling machines, universal emery grinders, surface grinders, drill-presses, forges, annealing ovens, and every device known to facilitate speed and accuracy in making and repairing dies, tools and machinery.

The foreman of this room is a practical tool maker and designer of exceptional ability. He is in charge of and responsible for all tools and machinery in the shop. All tools go through his hands, when a job is finished for inspection, before being placed in the fireproof safe in the tool-room where all special tools are kept. After the special tools and attachments (except in some cases where complete machines are made for producing the parts) are finished, they are placed in the machines for which they are designed, the first operation being performed largely either by power-presses or screw machines.

Fig. 3 shows a group of nine blanking-presses. These machines likewise are in charge of a foreman having special knowledge of this class of machinery and familiar with all the pieces his machines produce. Nearly all of these presses can be fed by hand if desired. They also have automatic feeds and other special devices for handling special jobs with accuracy and precision, and are capable, collectively, of blanking, and in some cases bending and assembling 810,000 pieces of metal per day of ten hours if run continuously.

Fig. 4 shows two automatic presses, running on pieces used in a key socket, producing the metal parts shown in the corner of the picture, these metal pieces being blanked and formed complete by the machine. On account of the complicated nature and the great value of these machines (one in the foreground costing many thousand dollars) they run at comparatively slow speed, the two machines together being capable of producing in an uninterrupted run of ten hours

FIG. 7.—MACHINES FOR ASSEMBLING SCREWS.

36,000 complete metal parts for a key socket, except the screws and shells.

There are four other special presses not shown in the pictures, being in another section of the shop, which are used for special work, some of them running at as high a rate of speed as 250 revolutions per minute on simple blanking and bending operations, giving an additional maximum daily capacity of 600,000 pieces if run continuously for ten hours.

Fig. 5 shows a couple of automatic screw machines mentioned in the earlier part of this article. These machines form and thread small parts, shown in the margin, such as switch spindles, bushings, pins, T.-H. socket screws, etc., one machine producing over 8,000 pieces in a continuous run of ten hours on certain classes of work, and running in some cases three days with a single sharpening of tools and keeping within the limits of 0.001 of an inch. These machines feed, form, thread, drill and cut off the pieces, drop them into a receptacle separate from the chips, stop and ring a bell when out of stock, as one man remarked, "They know more than the operator." All screw machines are in charge of a foreman having special experience in this line.

In order to detect wearing and breaks in tools and to ensure absolute uniformity and interchangeability of parts, steel gauges are made for all pieces, and the work, as it comes through the various machines, is constantly tested to detect any variations. A group of these gauges is shown in Fig. 6.

From blanking-presses and screw machines, such pieces as are not finished there go to other machines for further operations, as drilling, tapping, etc. The matter of tapping different metal pieces and putting in the screws are operations which run into vast numbers, and the machinery for this purpose is the result

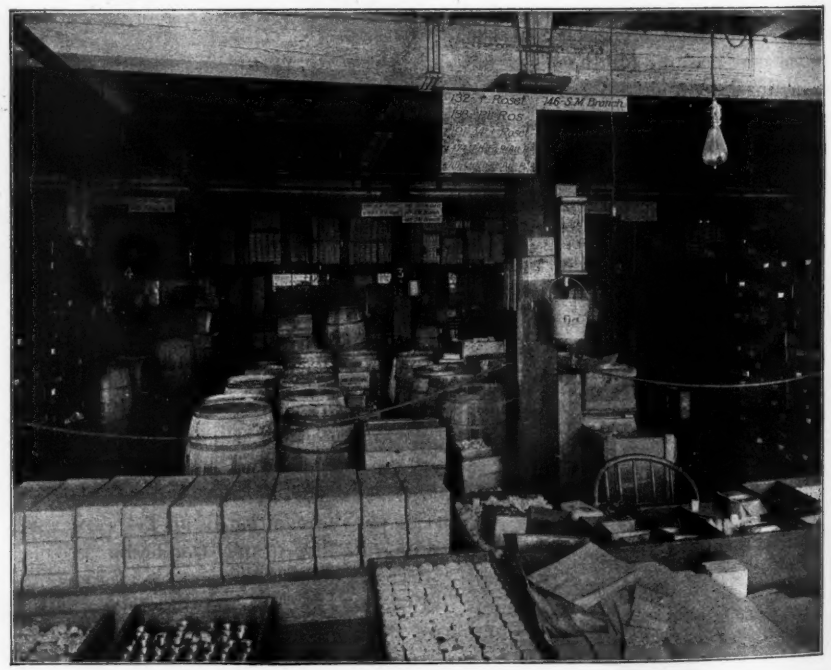


FIG. 8.—SECTION OF STOCKROOM.

of ingenuity of a high order, the work being done at a small fraction of what it cost a few years ago.

Fig. 7 shows one of the semi-automatic power machines putting screws into socket contacts, the screws being fed from a hopper automatically.

After the parts are completed in the

machine room, they are sent to the stockroom ready for assembling on the porcelain parts into finished goods.

Fig. 8 shows a section of the stockroom, heavy porcelain goods being in barrels and large boxes, the small metal parts in drawers in a rack, the location and space occupied by a given article being indicated by signs which show distinctly in the picture. The stockkeeper is thereby enabled to keep track of a complete set of parts required on a given product, with minimum expenditure of time and attention.

FIG. 9.—SOCKET AND CUTOUT ASSEMBLING ROOM.

From the stockroom parts are delivered to the assembling rooms, one of which, where sockets and cutouts are assembled, is shown in Fig. 9. This room is in charge of a foreman having many years' experience in making and handling the completed goods. In the foreground the inspectors are examining sockets; in the background some of the power-assembling machines are indistinctly visible. The assembling operations are subdivided to secure the most economical and perfect results, some operations being done by hand with a plain screw-driver, some are completed with special hand tools, while others are put together by power-driven, semi-automatic machinery. Every piece made, however, is carefully inspected by a skilled electrician familiar with every detail of the piece he inspects before it goes out.

The switch assembling room, not shown in any of the pictures, is in charge of a man of long experience in building switches, the work requiring assemblers of greater skill than is needed to assemble sockets and cutouts, and is therefore kept in a distinct department. Here, again, the operations are subdivided to obtain the most economical results. All switches are carefully inspected before leaving this room, and in addition a certain number from each lot are tested in the proving machine to develop any local fault of material or workmanship that may develop and escape the vigilance of the different inspectors. From the assembling rooms the goods go to the packing room, where they are wrapped and boxed for the removal to the shipping or storage room. Part of the storage room is shown in Fig. 10. In the shape shown in this view the goods are ready for shipping, and go to every part of the civilized world, a striking proof of the just claims that American electrical manufacturers are preeminent in nearly all divisions of the electrical field.

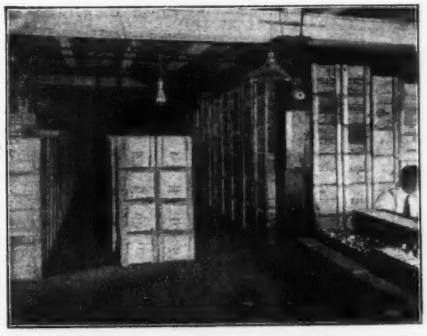
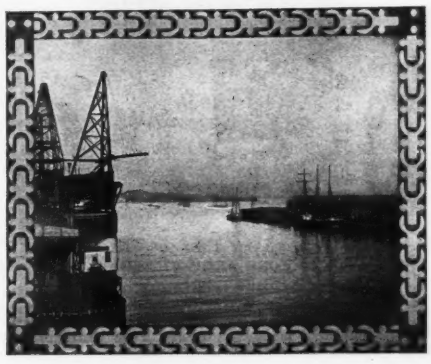


FIG. 10.—PART OF STORAGE ROOM.



VIEW FROM OFFICE WINDOW OF MARSHALL-SANDERS WORKS.

Oil Transformers.

The accompanying illustrations show some details of an oil transformer which has been on the market for some time and has been meeting with considerable success under all conditions of service. These transformers are made in various sizes from 0.6 to 50 kilowatts, the full line comprising sixteen standard sizes, which are wound for 1,000 or 2,000 volts primary, and 100 or 200 volts secondary. Some smaller sizes are wound for 50 or 100 volts secondary.

The shell cover has been chosen as best adapted for transformers intended for general use. The development of heat in transformers is due principally to the core loss, which is a constant all-day loss, making it necessary, therefore, to have as much as possible of the core surface exposed for radiation. These transformers have the highest magnetic circuit, with a maximum amount of surface of the cores exposed to the oil. In building the core one form of stamping is used. These stampings are built up in such a manner that all joints are broken and the reluctance is reduced to a minimum. The sheet steel entering into the construction is carefully annealed and tested before assembling to ensure a low ultimate core loss.

The valuable qualities of a good insulating oil include that of preserving the insulation, protecting the cores from moisture, conducting heat from the coils, and reinsulating punctures of the insulation of the coils caused by discharge of static atmospheric electricity. These transformers are equipped with a special grade of oil which has been found most suitable for such use, as it has a high flash-point and is especially prepared to free it from moisture.

The coils are machine wound, which ensures substantial and uniform construction and thorough insulation. They are wound in two sections, each section containing half of the primary winding and half of the secondary winding. The dimensions of cross-section are such that there is ample space between the coils and core for the circulation of oil. This is readily seen by an inspection of Fig. 1. This illustration shows the spacing strips holding the coils from the core and making a uniform space on every side, so that actually the coils are oil-insulated from the core. Additional protection of the primary winding by the interposition of the secondary coils is also a safeguard against breakdown from heating or through external cause.

The operating temperature of these

transformers is claimed to be very low. The free circulation about the coils inside the core, caused by the convection currents, tends to transfer the heat from the interior of the coils and core to the oil and case, where it is rapidly radiated. Fig. 2 shows the primary end of a transformer core and coils. Fig. 3 shows the secondary end of a transformer core and coils. Fig. 4 shows a transformer with cover removed.

The copper loss in these transformers, it is stated, has been reduced to a minimum by allowing a liberal cross-section of copper in the windings. The loss in the copper core is divided into two parts—the hysteresis loss, which is due to molecular action in the iron; and the eddy current loss, which is caused by actual electric currents in the iron itself. These transformers have been so proportioned that these iron losses are reduced to a minimum without in any way detracting from the other important results that

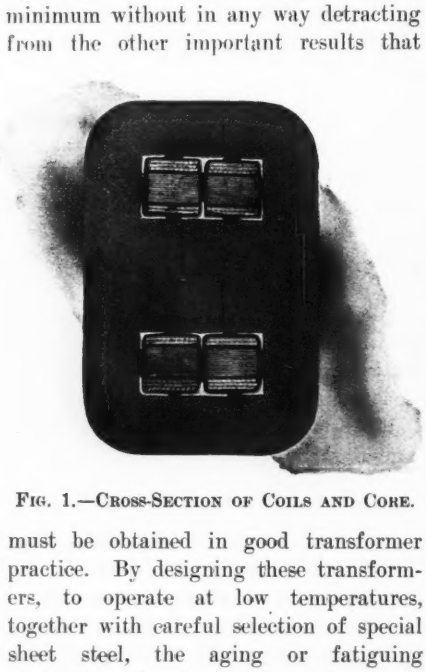


FIG. 1.—CROSS-SECTION OF COILS AND CORE.

must be obtained in good transformer practice. By designing these transformers, to operate at low temperatures, together with careful selection of special sheet steel, the aging or fatiguing of the iron has been reduced to a negligible amount. No effort has been spared in the design and construction of these transformers to increase the efficiency of the apparatus, and at the same time get the best results with regard to regulation, and they are claimed to maintain on three-wire circuits practically equal voltages on both sides, with a maximum unbalanced condition.

A rigid factory test is applied to each of these transformers before shipment, the insulation between primary and coil, and case and secondary coil, and primary and secondary coils being subjected to several times the normal operating potential under the most severe conditions liable to arise in practice. These tests are made for a long full load, heat run, and after the oil has been drawn from the case.

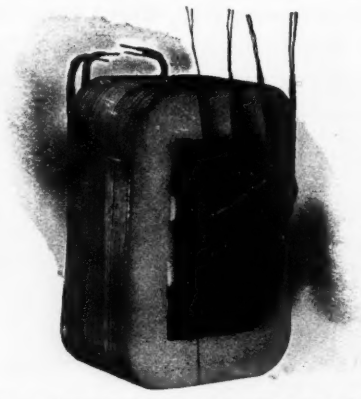


FIG. 2.—PRIMARY END OF TRANSFORMER CORE AND COILS.

The terminal leads from coils to line pass through and are sealed in extra heavy porcelain bushings, which are themselves sealed in a case, rendering all the joints moisture-proof and eliminating the possibility of grounds between the terminals and the case.

The transformer case is a single iron casting, of such shape and proportions as to give maximum strength and radiation surface with minimum weight. The case is provided with a vent at the bottom for drawing off the oil, should this become necessary. The cast-iron cover fits over the top of the case and is provided with a gasket, and is firmly fastened to the case with eye-bolts, making a thoroughly water-tight joint and preventing the escape of oil.

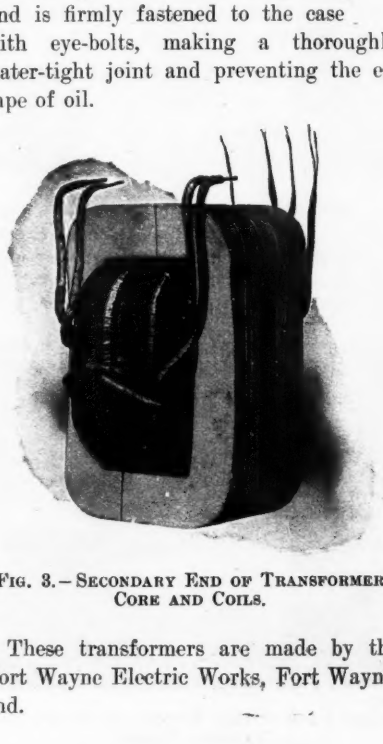


FIG. 3.—SECONDARY END OF TRANSFORMER CORE AND COILS.

These transformers are made by the Fort Wayne Electric Works, Fort Wayne, Ind.

New Factory for Manufacture of Automatic Telephone Apparatus.

The Automatic Electric Company, of Chicago, Ill., manufacturer of automatic switchboards and telephones, has moved from Washington and Union streets to the corner of Morgan and Van Buren streets, where it now occupies a large six-story factory building, which it has equipped with the very latest machinery.

The factory has a floor space of 100,000 square feet, and in its various departments 1,000 operatives will be employed. One hundred and fifty thousand dollars worth of new machinery has gone into the new building, and the company claims that it has the most modern telephone factory, and certainly the most unique, in America. This company was organized in December, 1901, and has not yet celebrated its first birthday, yet it makes the modest announcement that it is now manufacturing apparatus for three of the largest independent telephone exchanges which have ever been constructed, viz.,

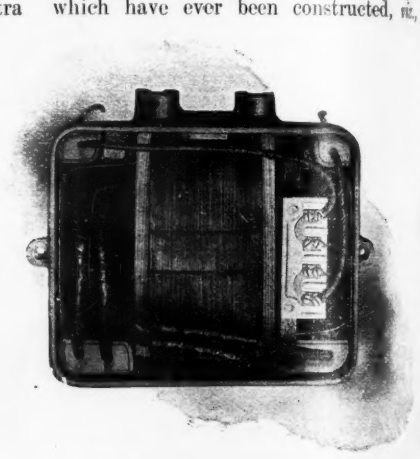


FIG. 4.—TRANSFORMER WITH COVER REMOVED.

Chicago, Ill.; Columbus and Dayton, Ohio, the total ultimate capacity of the three being 138,000 stations.

The offices of the company are located on the lower floor, and no expense has been spared in making them attractive and in every way suited to the needs of the office force. Each desk is equipped with an automatic telephone, and automatic telephones will be found in every department from basement to the sixth floor.

The switchboard which operates the company's lines is located in the main office on the first floor. Seventy-five switches are installed, but the ultimate capacity of the board is 1,000 lines. It is so placed that it may be used for demonstrating the operation of the automatic system to all visitors who are interested.

Two comfortable rooms will be fitted up for use of those who may be injured or suddenly become ill. One of these little hospitals will be for men; the other, which will be in charge of a matron, will be used by the 100 girls employed in the magnet wiring and bank building department. The company extends a cordial invitation to any one interested to visit its new headquarters.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

CABLE SERVICE REPAIRED—The Western Union Telegraph Company has received notice that the cable between the islands of St. Lucia and Grenada, in the West Indies, has been repaired, restoring telegraphic communication with St. Vincent, Barbadoes, Grenada, Trinidad and Demarara.

UNDERGROUND ROAD FOR BERLIN—A plan has been laid in Berlin before the municipal council for an underground electric railroad from the extreme north of Berlin to Hillisches Gate, ending at the suburb of Schoenburg, a distance of seven miles. Four years will be required for the construction of the road, and its cost is estimated at $14,000,000, to be covered by a loan.

ELECTRIC LIGHT DEAL—The Edison Light Company of Detroit has passed into the hands of New York and Boston capitalists, who propose to make extensive changes, more than doubling the capacity of the plant. The deal has been managed by W. F. White and C. W. Wetmore, of the Northern American Company, of Boston. It has been said that the syndicate will expend within the next two years more than $2,000,000 in Detroit on a new power plant, it being alleged that it has some special processes which it proposes to put in operation.

DENVER POWER COMPANY INCORPORATED—Articles of incorporation of the Denver Eureka Power Company have been filed in the Secretary of State's office. The company is organized to take over the holdings of the Eureka Ditch and Pipe Line Company which was organized in 1901, and has constructed ditches and dams. The capitalization is $3,000,000, and the company will operate in Arapahoe, Boulder, Clear Creek, Gilpin and Jefferson counties, with offices at Boulder. George H. Southman, William H. Sherrod and William F. Sperry are the directors of the company.

MEXICO'S BIG RAILWAY MERGER—The first real railway merger in which Mexican capital is interested exclusively has just been consummated in the state of Yucatan by the organization of the Consolidated Railroads of Yucatan, with a capital of $22,000,000. This has taken up all of the principal railroads on the peninsula. An American syndicate is negotiating for the purchase of a number of electric lighting plants in the northern part of Mexico. The plants are at Tampico, Victoria, Montemorelos and Linares. If the pending negotiations are successful, the syndicate proposes to extend its operations to other cities.

UNION OF OHIO ELECTRIC RAILWAY SYNDICATES—It is stated in Cleveland that there is very great significance in the proposed consolidation of the Elkins-Widener and Pomeroy-Mandelbaum syndicates. Representatives of Cincinnati and Boston bond houses are of the opinion that the consolidation would result in the formation of the strongest electric railway syndicate in the United States. It is asserted that the proposed syndicate will control the longest chain of electric railways in the world, covering more than 1,500 miles. Mr. F. T. Pomeroy, of Cleveland, Ohio, is credited with saying that there is no question as to what will ultimately happen. The various railways owned or controlled by the syndicate would be embraced in one large electric railroad.

NEW TACOMA ELECTRIC PLANT—It is stated that another large electric power plant will be established nine miles from Tacoma, Wash., by the parties owning the Snoqualmie Falls Power Company, which established the power plant at this place several years ago. Charles H. Baker and his associates in that company have secured control of the White River Power Company, which was incorporated several years as a New Jersey corporation. This company proposes to drain part of the flow of White River into Lake Taps, whence the water will be carried over the high bluff near Sumner. This will generate about 12,500 horse-power. The project has been consolidated with the Snoqualmie Falls power plant, and to accomplish this purpose the Snoqualmie Falls & White River Company has been incorporated with a capital of $2,000,000. The company will transmit power to cities and towns scattered from the British line to Portland, Ore. Power for Tacoma, Portland and other intermediate towns will be furnished by the White River Power Company, while the Snoqualmie company will furnish power to Everett, Seattle and other towns in the northern part of the state.

CAPITALISTS INSPECT THE CHICAGO TUNNEL—Fifty-six capitalists, representing an aggregate wealth of $200,000,000, recently inspected the telephone tunnel building in Chicago. They were the bondholders of the Illinois Telephone and Telegraph Company. Among the owners of the new telephone and telegraph company who composed the inspecting committee were the following: Robert Jadwin, Carbondale, Pa.; Homer Green and H. Z. Russell, Honesdale, Pa.; G. H. Flannagan, S. E. Innes, F. C. Johnson, C. E. Stegmaier, F. J. Stegmaier, Colonel G. N. Reichard, Dr. L. I. Shoemaker, P. A. Meixell, Liddon Flick, R. J. Flick and J. W. Hollenback, Wilkesbarre, Pa.; T. H. Phillips, Philadelphia; Colonel H. M. Boles, C. S. Weston, Edwin W. Gearhart, Byron Winton, T. E. Jones, Thomas Sprague, Grant Pelton, E. B. Eynon and Charles H. Welles, Scranton, Pa.; Colonel E. R. Payne and H. Collins, Williamsport, Pa.; M. W. O'Boyle, J. H. Foy, W. S. Staley and J. A. Law, Pittston, Pa.; Professor W. L. Dean and Dr. L. L. Sprague, Kingston, Pa.; E. B. Tustin, Bloomsburg, Pa.; Commander G. C. W. Lowrey and Clinton W. Wisner, New York; C. F. Wright, Susquehanna, Pa. Besides these were Clarence D. Simpson, Thomas H. Watkins, Charles B. Eddy and J. B. Russell of the banking firm of J. B. Russell & Company, forming what is known as the Simpson-Watkins Syndicate. J. B. Russell & Company, acting for the Simpson-Watkins Syndicate, are given the credit for interesting the men already named as bondholders in the telephone company.

NEW INCORPORATIONS.

WILMINGTON, DEL.—Merchants' Electric Company. $150,000.

OGDENSBURG, N. Y.—The G. H. Waldrudge Company. $400,000.

HARRISBURG, PA.—Summit Park Electric Company. $1,000.

NEW YORK, N. Y.—The London, Aylmer & North Shore Electric Railway Company. $500,000.

COLUMBUS, OHIO—Greenspring Telephone and Electric Company. Increased from $15,000 to $20,000.

DENVER, COL.—The Local Telephone Company. $500,000. Incorporators: H. H. Hake, C. L. Hake and F. P. White.

PARK FALLS, WIS.—Park Falls Water, Light and Power Company. $10,000. Incorporators: Edward P. Sherry, D. Marks, Marie Bluem.

PRINCETON, N. J.—University Power Company. $25,000. Incorporators: Robert H. McCarter, Edwin B. Williamson, Conover English.

SACRAMENTO, CAL.—Golden State Power Company. $10,000,000. Directors: C. L. Morrell, H. F. Lange, T. Getty, F. H. Powers, J. P. Gaffney.

MONTPELIER, IDA.—The Montpelier Electric Light Company. $25,000. Directors: J. A. Rostan, Charles Hoff, A. J. Bagley and W. E. Raines.

NEWARK, N. J.—The Hunterdon Power Transmission Company. $2,000. Incorporators: Edward A. Day, William T. Day and Jerome T. Congelton.

GOWANDA, N. Y.—Consolidated Electric Light and Power Company. $50,000. Directors: E. C. Fisher, C. S. Phelps, George J. Lincoln and C. G. Keyes.

AUGUSTA, ME.—Union River Light and Power Company. $1,000,000. Incorporators: A. Wendal Jackson, of New York city; I. L. Halman, Boston, Mass.

LOS ANGELES, CAL.—Whittier Light and Fuel Company, $100,000. Directors: A. Hadley, William H. Schwippe, F. O. Johnson, F. B. Braden, W. F. Jordan.

ELECTRIC RAILWAYS.

NEW YORK, N. Y.—Preparations are being made by the Long Island Railroad Company to operate the entire Rockaway branch by electricity. The trestle across Jamaica Bay is to be widened so that additional tracks may be laid.

LEXINGTON, KY.—A mass meeting of the citizens of Fayette and Bourbon counties was held recently for the purpose of considering the question of the construction of an electric railroad between this city and North Middletown. Resolutions have been passed authorizing the appointment of a committee from each county to look into the matter.

KNOXVILLE, TENN.—The Chattanooga Electric Railway has definitely determined to build a line to Chickamauga Park, and work will be begun at once. The first step to be taken will be the building of the line to Rossville, a distance of two miles. From this point the road will be built to Cloud Springs as soon as the necessary franchises can be obtained.

AURORA, ILL.—A certificate has been filed with the county recorder, certifying to the increase of the capital stock of the company which proposes to build an electric line from Aurora to De Kalb and Rockford from $100,000 to $1,500,000. The proposed line runs west from Aurora, through Kanesville to De Kalb, thence to Rockford, taking in the more important towns intervening.

JOPLIN, MO.—The Southwest Missouri Electric Railway is to be extended from Joplin to Carl Junction, Mo., ten miles north. The route has been decided on and much of the right of way has been secured. It is the intention of the company to eventually extend its line north from Carl Junction to Pittsburg, Kan., thus connecting the zinc fields of this district with the great coal fields of eastern Kansas.

VINCENNES, IND.—The Vincennes council has granted the Southern Traction Company, of which Smiley N. Chambers, of Indianapolis, is president, a fifty-year franchise. The company will operate an interurban passenger and freight line between Vincennes and Jasper, *via* Petersburg, a total distance of forty-four miles. The survey has been completed and work on the road-bed will begin at once.

WILMINGTON, N. C.—A deed of trust has been filed at Southport securing bonds to the amount of $800,000 for the Cape Fear Terminal Railroad Company, the Lincoln Savings and Trust Company, of Philadelphia, becoming the trustee. The terminal company is chartered to build a line of railway from Southport to Wilmington, with the ultimate purpose of extending the line or making traffic arrangements so as to enter the Virginia coal fields.

NASHVILLE, TENN.—A new interurban railroad is to be built in East Tennessee, to be known as the Cleveland & Ducktown Electric Railway. A charter has been granted to the concern, and it is said that the intention of the promoters is to build the road at once. It will run from Cleveland, in Bradley County, to Ducktown, in Polk County, and will then branch, one part running to Isabella and the North Carolina line, and the other to the Georgia line. The total mileage of the road will be forty or forty-five miles.

READING, PA.—The Electric Equipment Company, of this city, has purchased fifty-one per cent of the capital stock of the new Elmira & Waverly Electric Railroad Company. A meeting of the street commissioners will be held about November 10, when permission will be asked to construct the electric line, which, when secured, will be taken by the Reading company, and the road constructed between Elmira and Wellsburg this fall and finished to Waverly in the spring. The Elmira & Waverly company has issued $400,000 in bonds, which have been floated, with the Elmira Trust Company as trustee.

KALAMAZOO, MICH.—It is reported that a company in which S. J. Dunkley, of South Haven; Charles Williams, George E. Bardeen, of Otsego; William S. Dewing and other capitalists are interested will build an electric railway to connect Kalamazoo with South Haven, Benton Harbor, Holland and Grand Rapids. The line from South Haven to Kalamazoo, it is said, will be pushed rapidly. Later it will be extended to St. Joseph and Benton Harbor, and next summer extensions will be built to Douglas and Saugatuck, with connections with the Holland interurban road for Grand Rapids, Holland, Ottowa Beach and Macatawa. Franchises for a portion of the territory to be covered have already been granted.

PERSONAL MENTION.

MR. D. W. STEWARD, the well-known insulator manufacturer, of Chattanooga, Tenn., has recently been a visitor to New York city.

MR. CHARLES A. SANDERS, treasurer of the Marshall-Sanders Company, Boston, Mass., was a visitor to New York city during the week.

MR. F. C. PHILIPS, president of the Elwell-Parker Electric Company, of Cleveland, Ohio, was a New York visitor last week and attended the John Fritz dinner at the Waldorf-Astoria.

DOCTOR F. A. C. PERRINE and Mr. Ray D. Lillibridge were guests of the Michigan Lake Superior Power Company at the celebration of the opening of the 60,000-horse-power canal and powerhouse at Sault Ste. Marie, October 25.

DOCTOR HENRY S. PRITCHETT, president of the Massachusetts Institute of Technology, Boston, Mass., was a New York and Washington visitor last week, stopping over to attend the John Fritz dinner with Mr. Calvin W. Rice.

MR. J. C. BELDEN, formerly sales manager for the Kellogg Switchboard and Supply Company, Chicago, Ill., has established a business under his own name as the Belden Manufacturing Company, 118 Michigan street, Chicago. Mr. Albert Bentler is with Mr. Belden as superintendent of the new concern.

COLONEL WASHINGTON A. ROEBLING, after suffering for thirty years from the results of caisson fever which he contracted during the early work on the famous Brooklyn Bridge, was operated on in the Roosevelt Hospital, New York city. It is expected that this will restore him to complete physical comfort. His convalescence is now progressing very favorably.

MR. F. G. TALLMAN, general manager of the Brown Hoisting Machinery Company, of Cleveland, Ohio, visited the New York headquarters of his company in the Havemeyer Building in this city last week, where Mr. W. A. Stadelman ably presides over the company's affairs in the East. Both Mr. Tallman and Mr. Stadelman were guests at the John Fritz dinner in New York last week.

MR. LAMAR LYNDON, the well-known electrical engineer of New York city, has left his office in the Park Row Building for a short time in order that he might get the benefit of a very much needed rest. Mr. Lyndon has been working with accustomed vigor and perseverance on several projects which have overtaxed his strength and he is now recuperating at Saranac Lake in the Adirondacks.

MR. L. G. BOWMAN has recently joined the forces of the North Electric Company, of Cleveland, Ohio. Mr. Bowman has had considerable experience in the telephone field, his first position being with the Central Union Telephone Company, at Ravenna, Ohio, where he started in 1884, beginning as night operator and gradually advancing through the grades of lineman and inspector to manager of the district. He was with this company some seven years when he accepted a position with the New England Telephone and Telegraph Company, of Boston, where he remained about two years. In 1893 he was transferred to the New York Telephone Company, New York city, and placed in charge of the Spring street district which was then one of the largest in the city. He was with the New York company until the middle of 1896 when the independent telephone business began to show such increasing strength that he decided to engage in this field. His first work as independent was as manager of the Home Telephone and Telegraph Company, of Fort Wayne, Ind., where construction work had just begun and he remained there until the exchange was opened for business. At this time Fort Wayne was the largest independent telephone company in operation. After the completion of the Fort Wayne exchange he engaged with the Stromberg-Carlson company with whom he remained until 1900, contracting for some of its largest exchanges. Upon the reorganization of the Western Telephone Construction Company in 1900 he was appointed manager, and subsequently retired from this connection. Mr. Bowman in spite of his wide experience is still a very young man and the North Electric Company is to be congratulated upon the acquirement of his services.

ELECTRICAL SECURITIES.

Operations during the past week would seem to show that the upward tendency of prices in general had about come to an end, and that there was a prospect, for the immediate future at least, of a contraction of more or less magnitude in every line. A great deal, however, is thought to depend upon the outcome of the political contests on Tuesday, and as this is a period of particular and peculiar apathy in business quarters in every direction, conservative authorities do not feel that there is any extravagant cause of fear in the financial horizon. Predictions of gold exports have been made, and while this development is possible, the leading international banking houses regard it as improbable. In spite of the relief measures taken by the Treasury, the government withdrawals continue to be a disturbing influence. Recent estimates show that the government surplus for the present fiscal year will be between $45,000,000 and $50,000,000.

In connection with the government finances, it is interesting to note that the payment for the Panama Canal will probably be made this winter or early next spring. This will involve the cash payment to the foreign stockholders of $40,000,000, which will probably come in part out of the surplus and partly be covered by the bond issue provided for in the canal bill. The settlement of this debt will probably force gold exports, although it is probable that by the time this payment is due the exports of grain and cotton will reach proportions to greatly reduce the amount of gold necessary to be sent abroad.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 1.

New York:	Closing.
Brooklyn Rapid Transit	62⅞
Consolidated Gas	219
General Electric	186
Kings County Electric	205
Manhattan Elevated	137⅛
Metropolitan Street Railway	140
New York & New Jersey Telephone	164
Westinghouse Manufacturing Company	217

Manhattan Elevated Railroad made a gain of 2 points for the week. The earnings of the Brooklyn Rapid Transit Company continue to show an increase gratifying to the stockholders of that company. For October 30 the gross was $34,349, an increase of $1,023 over last year. For thirty days ending October 30, the gross was $1,037,173, an increase of $42,984 over last year. Since July 1 the gross is $4,469,521, an increase of $196,489.

Kings County Electric declined as from last week's figures, and now stands at 205.

Boston:	Closing.
American Telephone and Telegraph	164
Edison Electric Illuminating	267½
Massachusetts Electric preferred	96
New England Telephone	136¾
Western Telephone & Telegraph preferred	99

Philadelphia:	Closing.
Electric Company of America	9¾
Electric Storage Battery common	87
Electric Storage Battery preferred	87
Philadelphia Electric	8¾
Union Traction	47¼
United Gas Improvement	114

Philadelphia Electric was conspicuous in late local transactions, advancing ¼ to 9 on sales of nearly 2,000 shares.

Chicago:	Closing.
Chicago Edison Light	107
Chicago Telephone	168
Metropolitan Elevated preferred	89
National Carbon common	30
National Carbon preferred	100
Union Traction common	18
Union Traction preferred	50

Three of the four elevated railroads in Chicago established new traffic records in October. Metropolitan led in both the amount and percentage of increase. Its daily average of passengers was 115,980, an increase of nearly 21 per cent over the business in the corresponding month of last year. The Northwestern Elevated Company carried an average of 69,562 passengers a day during the month, exceeding its best previous figures by above 4,000. The South Side Elevated collected an average of 83,112 fares a day during the month, 13.76 per cent more than in the same month of last year.

LEGAL NOTE.

WESTERN UNION WINS—An important principle of law has been established by Judges Jenkins, Grosscup, Baker and Bunn, of the United States Circuit Court of Appeals, in handing down an opinion last week to the effect that the Western Union Telegraph Company has a right of property in the news which it gathers, and that right does not cease when the news is published on the tickers rented to its patrons. In laying down this principle, the Court of Appeals affirms two decisions of the lower court, and forever enjoins the National Telegraph News Company, the Illinois Commission Company and other defendants from taking the quotations in question. The court holds in brief that while the printed matter on the tape of the telegraph company is in no sense copyrightable, yet the business in question involves the use of property, and this service is not to be outlawed. The judges point out that while a law has not hitherto been fitted to a case of this kind, it is the duty of the court to make a precedent.

RECEIVERSHIP NOTE.

THE AMERICAN UNION ELECTRIC COMPANY, New York city, has been placed in the hands of a receiver at the instance of F. C. Hollins, of the financial house of F. C. Hollins & Company, New York city. The American Union Electric Company is a corporation organized last summer for the purpose of acquiring the business of several railway equipment and electrical concerns. Its authorized capital was $4,000,000. The company took over the Morris Electric Company, the Union Railway, Power and Electrical Company, the Falcon Electrical Manufacturing Company, the Electrical Motor Specialty Company, the Refrigerator Machine Company, the Fountain Manufacturing Company, the Metropolitan Switchboard Company, and the Federal Manufacturing and Specialty Company. An extensive plant has been erected at Ampere, N. J., for the manufacture of rail-bonds, fare registers, sweepers, headlights, trucks, trolley wheels, car trimmings and electrical devices. The management of the company was, until recently, under the guidance of Messrs. Elmer P. Morris, S. Marsh Young, E. P. Ewing and J. Fountain.

OBITUARY NOTICE.

MR. ARCHIBALD CLARKE, No. 210 West Hamilton place, Jersey City, N. J., superintendent of construction for the Western Union Telegraph Company's line along the Erie Railroad, dropped dead in the Jersey City terminal of the railroad company on Friday morning, October 24. He was a victim of apoplexy. Mr. Clarke was fifty-five years of age, and entered the service of the telegraph company in 1871.

INDUSTRIAL ITEMS.

THE STANDARD TOOL COMPANY, Cleveland, Ohio, manufacturer of twist drills, reamers, chucks, spring cotters, taps and a large variety of mechanical appliances, has ready for distribution a very complete catalogue which it will be pleased to send to any one interested upon request.

THE WHEELER REFLECTOR COMPANY, on account of a large increase of business, has been forced to seek new quarters and about November 1 will remove to No. 156 Pearl street, Boston, Mass., where with largely increased room and new and important machinery it will be enabled to meet with great facility the demands of its customers.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., manufacturer of electrical and heating apparatus, under the influence of the colder weather is being greatly taxed to supply the orders secured for its heating apparatus. The electric stoves manufactured by this company are especially adapted for offices, waiting-rooms, bathrooms, nurseries and cold corners. Full information will be mailed to any one interested.

MESSRS. SCHLESINGER & MEARS, 220 Broadway, New York city, are celebrating the first anniversary of their business relations. This firm has met with marked success in every undertaking, and its popularity is constantly increasing. The company is the manager for New York city of the "Hanoy Jr." one-wire telephone, manufactured by the Haines & Noyes Company, of Chicago, Ill., for which a large demand is being evidenced.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is distributing literature illustrating and describing three styles of the

Newgard combined water-proof globe and receptacle. This apparatus is designed with special attention to use in conditions of service where moisture must be contended with.

GEORGE C. EWING has opened offices in the Board of Trade Building, 131 State street, Boston, Mass., for the sale of Nernst lamps and electric railway and lighting supplies.

THE LUNKENHEIMER COMPANY opened its new Fairmount works on Saturday evening, October 25. Admission was by card, and a most enjoyable time was spent by those who were fortunate enough to be present.

SARGENT, CONANT & COMPANY, Boston, Mass., has purchased the construction business of the Hawks Electric Company, of that city, together with the good will, stock tools, etc., appertaining thereto, and will complete its outstanding contracts.

THE JANDUS ELECTRIC COMPANY has just equipped the new department store of R. H. Macy & Company, in New York city, with 1,300 enclosed arc lamps. This is claimed to be the most extensive installation of enclosed arc lamps in any building throughout the world.

N. A. CHRISTENSEN announces that the Christensen Engineering Company, with whom he has been connected as superintendent since its organization and as consulting engineer, will hereafter manufacture his air compressors connected with air brakes exclusively.

THE HAINES & NOYES COMPANY is meeting with great success in placing orders for its "Hanoy Jr." one-wire telephone. Messrs. Schlesinger & Mears, the New York managers of the company, are located at 220 Broadway, and report large sales of this instrument.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is meeting with continued success with its electric motor controller devices. The company's perpetual catalogue will be sent to any one upon application, and is an exposition of what is possible in the manufacture of high-class rheostats.

THE OTIS ELEVATING COMPANY, New York city, has recently received contracts for the elevator and dumb-waiter equipment of the New Astor Hotel, New York city. The plant consists of seven electric passenger elevators, two electric servants' elevators, eleven electric dumb-waiters and three electric sidewalk lifts.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, Ohio, is presenting its friends with an elaborate souvenir of an embossed reproduction of the famous painting, entitled "Diana's Chase." In addition to the picturesque adornment of the plague, there is a handsome reproduction of the Sterling special with the quotation that "This is the lamp that makes Warren famous."

JAMES S. BARRON & COMPANY, New York city, are the sole agents for the Harloe self-tying insulators. These insulators are made in porcelain and glass for outside and inside construction for telephone and telegraph, electric light and power purposes. These insulators can be put on with great rapidity, and their special construction doing away with the use of tying wires is making them very popular in this field.

THE WESTERN ELECTRIC COMPANY, New York city, has just issued a handsome catalogue describing its exhaust fans and steel-plate blower equipments. Tables of dimensions are given with each type of apparatus and a number of half-tone reproductions give a very good idea of the appearance of this equipment. The bulletin also contains a number of illustrations and descriptions of motor-speed controllers and motor starters. This bulletin will be sent to any one upon request.

EUGENE MUNSELL & COMPANY, New York city, has recently begun the manufacture of a mica chimney for incandescent gas burners, which it claims to have many advantages. This is known as "Warren's Folding Interlocking Mica Machinery," and application has been made for a patent on this unique and yet simple style of construction. The chimney is packed and sold flat like a sheet of paper, and it can be formed into a cylinder as easily, the edges interlocking as implied by the name. This makes it possible to clean the chimney when necessary, easily and thoroughly, by unlocking and laying out flat. Complete information regarding this will be sent to any one upon request to the company.

THE UNION STEEL COMPANY, Pittsburg, Pa., will adopt electrical power distribution for its new mills. The power will be generated by steam from the waste gases from the blast furnaces, and will be distributed in the form of alternating current to rotary converters at the mills, where it will be used largely as direct current. The company has recently purchased from the Westinghouse Electric and Manufacturing Company two 800-kilowatt, alternating-current generators, one 800-kilowatt, direct-current generator, and five rotary converters.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., is bidding on a large amount of pole business this fall. This company has good facilities for the prompt shipment of cedar poles, and has arranged for special treatment from the freight departments of the carrying railroads. The Kellogg company subjects every pole to a rigid inspection before it is landed in the yard, and a high-grade stock of poles is thereby maintained. The company has a fine lot of six-inch twenty-five-foot poles, and suggests that these are ready at a true bargain figure. A complete stock of all other standard sizes is also carried.

THE ELECTRICAL EQUIPMENT COMPANY, Monadnock Building, Chicago, Ill., has been awarded a contract for the complete installation of a lighting plant for the city of Washington, Iowa. The equipment includes a Westinghouse three-phase, sixty-cycle generator, direct-connected to an Ideal engine. Work is now under way and the plant will be in operation about January 1. The same company has also been awarded a contract for the complete installation of a water-power electric transmission plant for the Rouge River Light and Power Company at Rockford, Mich. The equipment includes two General Electric generators and various motors ranging in size from ten to fifty horse-power. This plant will be in operation about December 1.

WESTINGHOUSE, CHURCH, KERR & COMPANY, New York city, reports extensive sales of Roney mechanical stokers for the past month. Among the orders are the following: Carnegie Steel Company, Homestead Works, twelve duplex stokers to replace those of another make, fifth order follows a large order given one year ago, total, 15,000 horse-power; Lackawanna Steel Company, Buffalo, sixteen duplex stokers (fourth order), 14,000 horse-power; Juniata Steel and Iron Company, Greencastle, Ind., ten duplex stokers; Continental Tobacco Company, St. Louis, Mo., four duplex and one quadruplex stokers (third order); Atlantic Rolling Mill and Tin Plate Company, Atlanta, Ind., eight duplex stokers; Woodward & Lothrop, Washington, D. C., six duplex stokers; Merchants' Heating and Light Company, Indianapolis, Ind., five duplex stokers; duplex and quadruplex stokers are also to be installed in the J. L. Mott Iron Works, Trenton, N. J.; American Locomotive Works, Schenectady, N. Y. (fourth order); Pennsylvania Railroad, Altoona, Pa. (tenth order); United States Lighting and Power Company, Washington, D. C.; National Tube Company, Pittsburg, Pa. (sixth order); Pressed Steel Car Company, Pittsburg, Pa. (sixth order).

MR. H. M. SALMONY, 95 Mortimer street, London, England, has outlined a proposition, which in its magnitude is little beyond anything which the ordinary business representative has yet undertaken. He has been quite successfully representing several American manufacturers in England and on the Continent of Europe. All his business, however, has heretofore been conducted by correspondence, and this he has found did not achieve as good results as would be possible if there was on the spot an American representative to qualify the superior features of American made apparatus. His scheme is to establish in all of the large foreign countries an American electrical trading exposition where he would make an imposing display of manufacturers' samples, and in this way thoroughly canvass desirable firms and central station electricians. Prior to his travels in the British Kingdom and on the Continent of Europe, it is his intention to visit the United States and come in personal contact with the prominent electrical manufacturers here. His purpose is to represent only one line of goods for an individual manufacturer of a particular kind. At the same time, he expects to cover the entire range of electrical goods and electrical machinery. Mr. Salmony expects to arrive in the United States in a short time.